

# RFID: SOLUTIONS WITHOUT A BARRIER

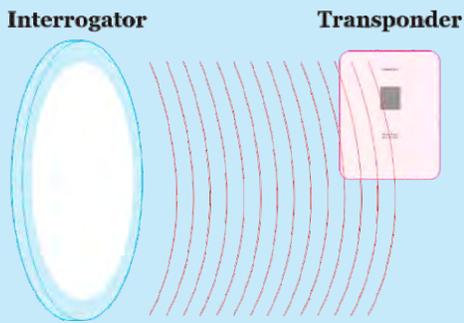


# INTRODUCTION

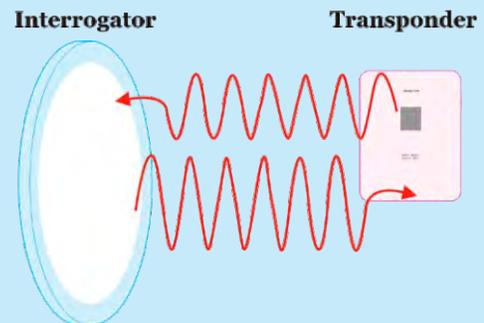
Radio Frequency Identification (RFID) systems carry/process data in suitable transponders, generally known as tags, and then the data is retrieved at a suitable time and place through RF means. It is sometimes called dedicated short-range communication (DSRC). The purpose of an RFID system is to enable data to be transmitted by a portable device, called a tag, which is read by an RFID reader and processed according to the needs of a particular application. The data transmitted by the tag may provide identification or location information, or specifications about the product tagged, such as price, color, date of purchase, etc. As the technology is refined, more pervasive and invasive uses for RFID tags are in the works.

# RFID SYSTEM

In a typical RFID system, individual objects are equipped with a small, inexpensive tag, which contains a transponder with a digital memory chip that is given a unique electronic product code. The interrogator, an antenna packaged with a transceiver and decoder, emits a signal activating the RFID tag so it can read and write data to it. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing.



A, Passive RFID System



B, Active RFID System



## RFID TRANSPONDER TYPES

A number of features, in addition to carrier frequency, characterize RFID transponders and form the basis of device specifications, including:

- » Means by which a transponder is powered
- » Data carrying options
- » Data read rates
- » Programming options
- » Physical form
- » Costs

### Powering tags

For tags to work they require power, even though the levels are invariably very small (micro to milliwatts). Tags are either passive or active, the designation being determined entirely by the manner in which the device derives its power.

Active tags are powered by an internal battery and are typically read/write devices. They usually contain a cell that exhibits a high power-to-weight ratio and are usually capable of operating over a temperature range of  $-50^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ . The use of a battery means that a sealed active transponder has a finite lifetime. However, a suitable cell coupled to suitable low power circuitry can ensure functionality for as long as ten or more years, depending upon the operating temperatures, read/write cycles and usage. The trade-off is greater size and greater cost compared with passive tags.

In general terms, active transponders allow greater communication range than can be expected for passive devices, better noise immunity and higher data transmissions rates when used to power a higher frequency response mode.

Passive tags operate without an internal battery source, deriving the power to operate from the field generated by the reader. Passive tags are consequently much lighter than active tags, less expensive, and offer a virtually unlimited operational lifetime. The trade-off is that they have shorter read ranges than active tags and require a higher-powered reader. Passive tags are also constrained in their capacity to store data and the ability to perform well in electro magnetically noisy environments. Sensitivity and orientation performance may also be constrained by the limitation on available power. Despite these limitations passive transponders offer advantages in terms of cost and longevity. They have an almost indefinite lifetime and are generally lower on price than active transponders.

### Data carrying options

Data stored in data carriers invariably require some organization and additions, such as data identifiers and error detection bits, to satisfy recovery needs. This process is often referred to as source encoding. Standard numbering systems, such as UCC/EAN and associated data defining elements may also be applied to data stored in tags. The amount of data will of course depend on application and require an appropriate tag to meet the need. Basically, tags may be used to carry:

- » Identifiers, in which a numeric or alphanumeric string is stored for identification purposes or as an access key to data stored elsewhere in a computer or information management system.
- » Portable data files, in which information can be organized, for communication or as a means of initiating actions without recourse to, or in combination with, data stored elsewhere.

In terms of data capacity tags can be obtained that satisfy needs from single bit to kilobits. The single bit devices are essentially for surveillance purposes. Retail electronic article surveillance (EAS) is the typical application for such devices, being used to activate an alarm when detected in the interrogating field. They may also be used in counting applications.

Devices characterized by data storage capacities up to 128 bits are sufficient to hold a serial or identification number together, possibly, with parity check bits. Such devices may be manufacturer or user programmable. Tags with data storage capacities up to 512 bits, are invariably user programmable, and suitable for accommodating identification and other specific data such as serial numbers, package content, key process instructions or possibly results of earlier interrogation/response transactions.

Tags characterized by data storage capacities of around 64 kilobits may be regarded as carriers for portable data files. With increased capacity the facility can also be provided for organizing data into fields or pages that may be selectively interrogated during the reading process.

## Data read rate

It has been mentioned already that data transfer rate is essentially linked to carrier frequency. Higher the frequency, generally speaking, higher will be the transfer rates. It should also be appreciated that reading or transferring the data requires a finite period of time, even if rated in milliseconds, and can be an important consideration in applications where a tag is passing swiftly through an interrogation or read zone.

## Data programming options

Depending upon the type of memory a tag contained data may be read-only, write once read many (WORM) or read/write. Read-only tags are invariably low capacity devices programmed at source, usually with an identification number. WORM devices are user programmable devices. Read/write devices are also user programmable.

## Physical Form

RFID tags come in a wide variety of physical forms, shapes, sizes and protective housings. Animal tracking tags, inserted beneath the skin, can be as small as a pencil lead in diameter and ten millimetres in length. Tags can be screw-shaped to identify trees or wooden items, or credit card shaped for use in access applications. The anti-theft hard plastic tags attached to merchandise in stores are also RFID tags, as are heavy-duty 120 by 100 by 50 millimeter rectangular transponders used to track inter-modal containers, or heavy machinery, trucks, and railroad cars for maintenance and tracking applications.

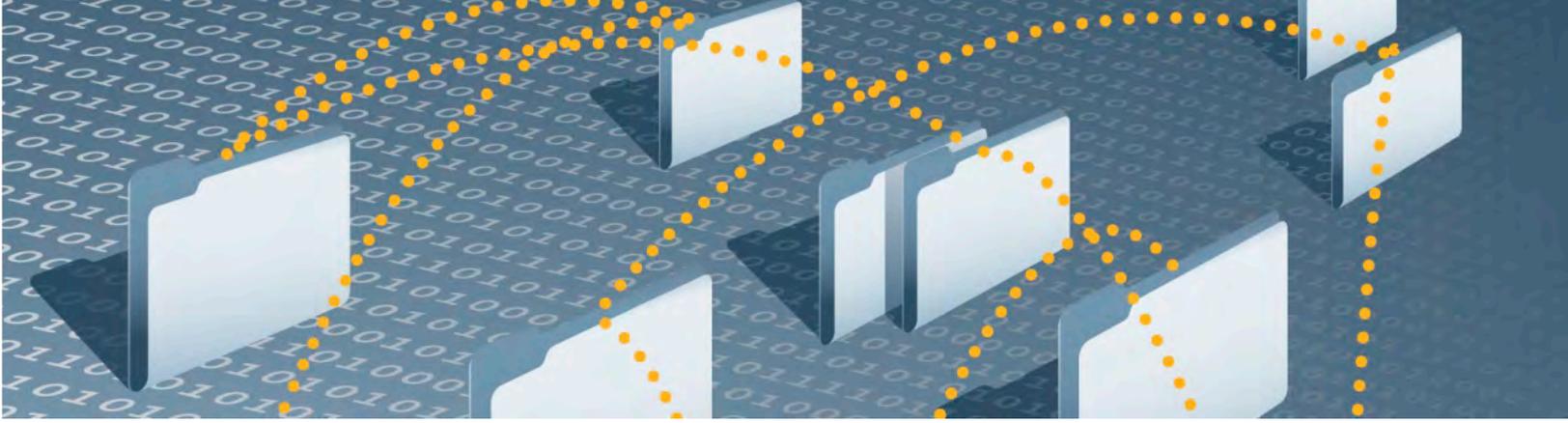
## Costs

The cost of tags obviously depends upon the type and quantities that are purchased. For large quantities (tens of thousands) the price can range from less than a few tens of pence for extremely simple tags to tens of pounds for the larger and more sophisticated devices.

Increasing complexity of circuit function, construction and memory capacity will influence cost of both transponders and reader/programmers.

The manner in which the transponder is packaged to form a unit will also have a bearing on cost. Some applications where harsh environments may be expected, such as steel mills, mines, and car body paint shops, will require mechanically robust, chemical and temperature tolerant packaging. Such packaging will undoubtedly represent a significant proportion of the total transponder cost.

Generally, low frequency transponders are cheaper than high frequency devices; passive transponders are usually cheaper than active transponders.



## THE APPLICATIONS

Principal areas of application for RFID that can be currently identified include

- » Transportation and logistics
- » Manufacturing and Processing
- » Security and Tracking
- » Time logging

Some of the more prominent specific and applications include:

- » Electronic article surveillance - clothing retail outlets being typical.
- » Protection of valuable equipment against theft, unauthorized removal or asset management.
- » Controlled access to vehicles, parking areas and fuel facilities - depot facilities being typical.
- » Automated toll collection for roads and bridges - since the 1980s, electronic Road-Pricing (ERP) systems have been used in Hong Kong.
- » Controlled access of personnel to secured or hazardous locations.
- » Time and attendance - to replace conventional "slot card" time keeping systems.
- » Animal husbandry - for identification in support of individualized feeding programmes.
- » Automatic identification of tools in numerically controlled machines - to facilitate condition monitoring of tools, for use in managing tool usage and minimizing waste due to excessive machine tool wear.
- » Identification of product variants and process control in flexible manufacture systems.
- » Sport time recording
- » Electronic monitoring of offenders at home
- » Vehicle anti-theft systems and car immobilizer

## Standardization

If the unique advantages and flexibility of RFID is the good news, then the proliferation of incompatible RFID standards with are the corresponding bad news. All major RFID vendors offer proprietary systems, with the result that various applications and industries have standardized on different vendors' competing frequencies and protocols. The current state of RFID standards is severe disarray - standards based on incompatible RFID systems exist for rail, truck, air traffic control, and tolling authority usage.

The lack of open systems interchangeability has severely crippled RFID industry growth as a whole, and the resultant technology price reductions that come with broad-based inter-industry use. However, a number of organizations have been working to address and hopefully bring about some commonality among competing RFID systems, both in the U.S. and in Europe where RFID has made greater market inroads. Meanwhile in the U.S.A., ANSI's X3T6 group, comprising major RFID manufacturers and users, is currently developing a draft document based systems' operation at a carrier frequency of 2.45 GHz, which it is seeking to have adopted by ISO. ISO has already adopted international RFID standards for animal tracking, ISO 11784 and 11785.

## Security Concerns

More recently, the news that cryptographers have cracked the TI 40-bit encryption code used in some automobile immobilizers and the Exxon/Mobile SpeedPass continues to fuel the security concerns. While there's no denying that the cryptographers succeeded, the potential "threat" is wildly overstated. Presently several different layers of security were built into the system and a 128-bit encryption technology is evolved which is slated to replace any old form of encryption including the 40-bit technology studied by the researchers.

## Privacy Issues

There are also worries that someone with a very large antenna and (illegally) powerful reader could, theoretically, covertly read EPC item level tags from a great distance. Similarly public will always going to have a fear about the nature and the extent of the data carried by RFID tags how much ever the assurance given by the manufacturers. Probably this is an issue, which has to be tackled by proper information dissemination to the public and sound legislation from the government side.

### ABOUT ALTEN CALSOFT LABS

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