

# RFID TECHNOLOGY: A NEW APPROACH TO CIRCULATION OF LIBRARY RESOURCES

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## ABSTRACT

*Circulation and shelving of the reading material in a library is quite a cumbersome work which takes most of the time of the library staff. RFID provides a solution to such a problem, by reducing the amount of time required to perform circulation operations. The paper covers the components and technical features of a modern RFID library system.*

## INTRODUCTION

Today libraries are at the threshold of electronic age. Within the library number of printed, non-printed (e-form) and other reading materials are available. Managing and maintaining this library material can be time consuming and costly process for librarian, library staff and institutional administrator. For many years, libraries have used number combination of technologies to reduce the stocktaking, seed up circulation procedure But, we know new technologies have always been bringing the new face to libraries for improving efficiency of library operations. Hence at present, using RFID technology is capable improving upon existing system.

## WHAT IS RFID ?

RFID technology was discovered in year of 1948. The technology have created emerging applications for

tracking, sensing, and identifying various targets in wide-ranging areas such as Transportation Toll bridges, supply chain, airline baggage handling, medical and biological industry.<sup>1</sup>

The RFID Technology used very variety of radio frequencies and techniques. Among them, ultra-high frequency (UHF) band passive RFID systems that operate in the 860 – 960MHz band has drawn a great deal of attention because of its numerous benefits, such as cost, size, and increased interrogation range. In particular, the interrogation range of the UHF RFID system is comparatively large, due to the use of travelling electromagnetic (EM) wave to transfer power and data.

UHF band passive RFID system based on modulated backscatter has a unique characteristic, quite distinct from those encountered in most other radio systems which involve active transceivers on both sides of the link (wireless LAN, Bluetooth, etc). Because tag has no internal power supply, RFID

reader must always supply the power in order to communicate with tags.

### HOW DOES RFID SYSTEM WORK

RFID Link is one of the important aspects of technology. It is depend on two types of tags these tags are called active tags and passive tags. The Active tags works on the power which is stored in them by any mean mostly some battery type device while the passive tags works when they come in the contact of electromagnetic field of reader or antenna and takes energy from radiation. Actually the intake of passive tags comes from continuous wave signals of radar. When these tags come at

electromagnetic field of radar (reader) the link is established.

There are two type of link which works for establishing a connection between radar and tags here radar is base station which is connected with the computer and use forward link while tags are called as mobile station and use reverse link. The forward link is the communication link from a base station (BS) to a mobile station (MS), whereas the reverse link is the opposite communication link, from Mobile Station to Base Station. Because Base Station and Mobile Station can simultaneously transmit data to each other through the forward and reverse links, a typical communication link is called full duplex.

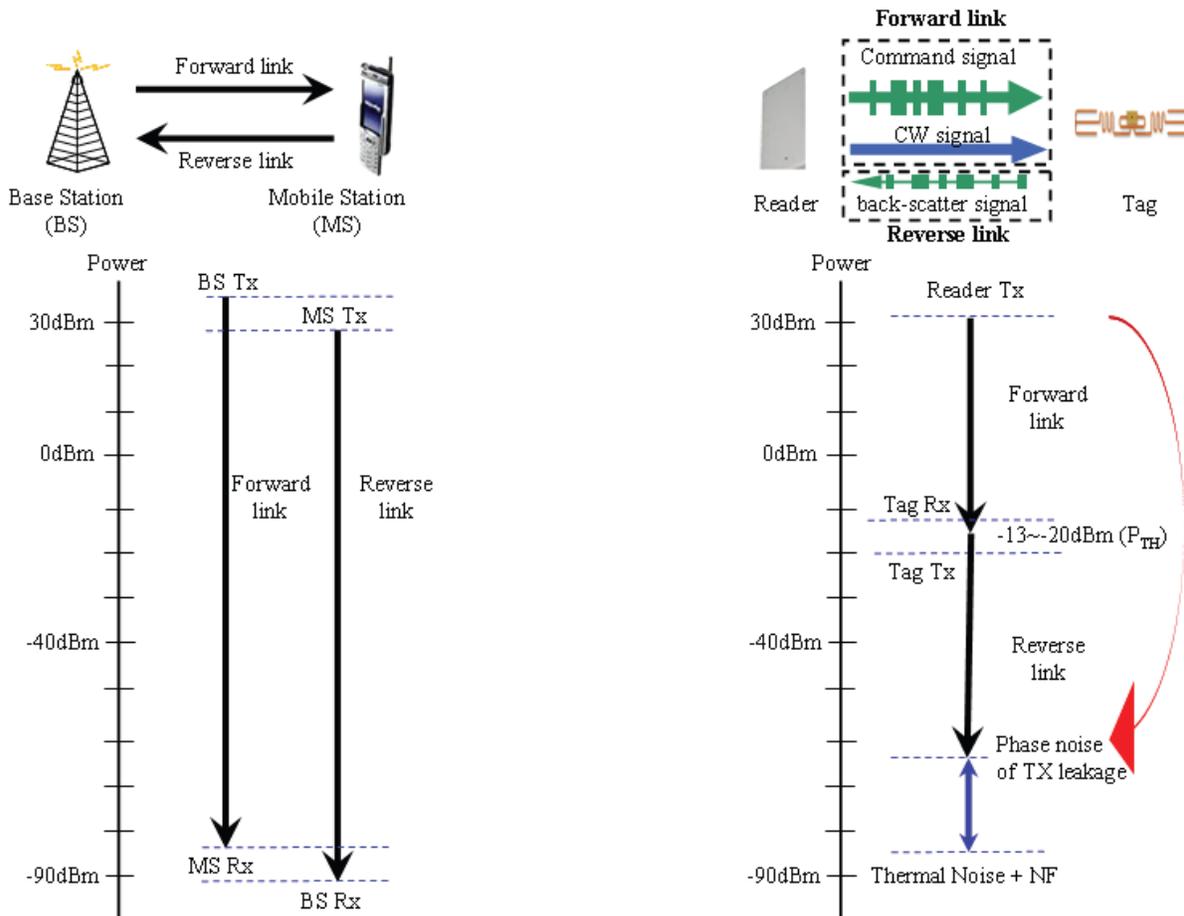


Fig. No. RFID System<sup>2</sup>

## COMPONENT OF RFID

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A typical RFID system has various component and they perform when they integrate well. The understanding of component's work is the important aspect of system. The system consist of following aspects-

### RFID TAG

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RFID tags consist of a microchip connected to an antenna, which is constructed of a small coil of wires. The assembly is usually covered with a protective layer (such as a laminated card), which is determined by the type of application. The RFID tag can be a passive tag or an active tag.<sup>3</sup> The RFID tag is also known as an inlay.

#### **Components of passive RFID system:**

- An antenna is attached to a microchip.
- The antenna allows the chip to transmit information to a reader, which also has an antenna.
- The reader is the device that actually sends out the radio waves to create a magnetic field. A passive RFID tag draws its power from this magnetic field, which powers the circuits in the microchip allowing it to transmit data back to the reader.
- Reader transmits to a computer system.
- The computer passes data onto a network.
- Software determines how the data received should be used.

### RFID TAG SHAPES AND SIZES

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RFID tags can be manufactured in several different shapes and sizes depending on the type of application in which they will be used.

- Some are the size of a pencil lead or are less than a half-inch in length and can be inserted under the skin of animals and livestock.
- Screw-shaped tags are used to identify specific trees.
- Rectangular RFID tags found in some products are used as an anti-theft device.
- Large, heavy duty tags that are several inches in length, width, and depth are used to track large containers or large vehicles such as trucks or rail cars<sup>4</sup>

### MICROCHIP

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The most expensive read/write, active RFID transponders may have microchips with a memory capacity of up to one megabyte (1,000,000 characters). Most tags are inexpensive, passive transponders that can store only 32 to 128 bits (characters) of information or less, so an identification number is basically the only data that the read-only tag will contain. When the number is read, detailed information stored in a database in a computer can be accessed. This is similar to a barcode system in which data, such as a price, is accessed when the barcode is read. The main difference is that the barcode must come in direct contact to an optical scanner/reader and the RFID tag can transmit to the reader via radio waves and does not have to be in direct contact.

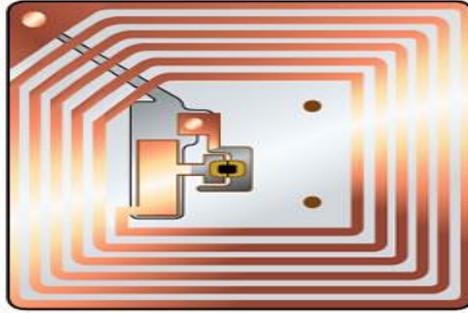


Figure no. 2: Microchip<sup>5</sup>

## ANTENNA

The antenna allows the chip to receive and relay information, such as an ID number of an individual product. Some antennas are constructed of metal and are etched or stamped from metal, such as copper. Other types of antennas are printed. Advances in technology are allowing printed antennas to achieve the functionality of traditional materials and printed antennas are less expensive. One of the most popular methods of printing antennae is with the use of silver conductive inks printed on plastics substrates or paper. Testing of RFID antennae is usually performed with ohmmeters, milliohm meters, RF network analyzers, impedance-measuring equipment, and others<sup>6</sup>

## RADIO FREQUENCIES

RFID tags operate under different radio frequencies, depending on the application. The FCC of the US government determines the limits on power output of RFID systems as well as the different radio frequencies that can be used. Low, high, and ultra-high (UHF) frequencies are used with RFID transponders.

- Low and high frequency tags are less expensive than UHF and are best used for merchandise tracking, animal and livestock identification, and security access.
- Tags with UHF frequencies use more power than low and high frequency tags, but they have a greater range and the data transfer rate is faster. They are best suited for applications in which the tag and the reader have a more direct path with one another. Rail car tracking and automated toll booths are some of the uses.

The communication range between the RFID tag and the reader depends on the frequency, the antenna size of the tag, the antenna size of the reader, and the output power.

- Low and high frequency devices have communication ranges of a few inches to several feet, depending on the application.
- Ultra-high (UHF) may have ranges of 25 feet or more.

The radio signals can go through many substances such as rain, fog, snows, dirt and grime, painted

surfaces, etc. This gives RFID tags a distinct advantage over optically read items, such as barcodes, which would be useless under similar conditions. An RFID reader can receive data from as many as 1,000 tags per second<sup>7</sup>.

## BARCODE TECHNOLOGY VS RFID TECHNOLOGY

The significant difference in barcode and a RFID system is that barcode use particular protocol of language such as code 39, 80 etc while RFID use no protocol. The protocol for barcode is important because it is read by the scanners and manufacturer of scanners decide the ability of reading based on code(or Protocol) The well connected tags of RFID system do not follow any protocol for transaction. However Protocol are important and some efforts are going on in this regard.

S. No.	Barcode	RFID
1	Use Scanners and barcode level	Use Antenna and tags
2	Use Standard protocols	Do not follow protocols
3	Issue single item at a time	Can deal multiple item at a time
4	Barcode Data are unidirectional(Can only Read not write)	Multi directional data is possible(Can read and write data)

## RFID TECHNOLOGY IN CIRCULATION PURPOSE IN UNIVERSITY LIBRARIES

RFID can be used library circulation operations and security systems. This technology move beyond security to become tracking systems that combine security with more efficient tracking of library resources throughout the library,including easier and faster charge and discharge and resources handling.(Boss 2004)

In Many Libraries the mainly the circulation is based on the barcode system. The barcode technology is now these days are a

backbone for libraries particular for circulation purpose. Barcode is machine printed lines on a label which can be read by scanners and use by Library management system. RFID technology has enabled self service and self return to operate successfully for many years, functions which have since come to be synonymous with RFID technology. the main advantage of RFID system is that it can deal many issue simultaneously and to allow items to be read without having to open them to find the barcodes.

## ISSUE OF BOOKS

Since long time back the Academics of Libraries have given emphasis to open access to readers. The quickest issue system not only save the time of readers but also give significant cost cutting solution to library Managers. The RFID system is capable to self issue system and meets both the goal of time saving as well as cost cutting. the methodology employed by RFID self-service is identical to that used for bar-coded stock for over 25 years. It is consequently very stable and well-understood. The only information required to make it work are the barcode numbers of the borrowers and the items<sup>8</sup>.

Self-issue counters come in a wide variety of shapes and sizes. Operation is straightforward, typically:

- First Borrowers present their identification to the unit. (This might be another RFID enabled card, a barcode or some other technology)
- Borrowers give PIN code to the system (Depend on library policy) they may be required to enter a PIN code or password.
- Items are placed on the reading table
- Items are read and passed for checking to the LMS
- The LMS returns its decision to the Self Service Unit (or SSU)
- Any items that may not be loaned will be

advised on screen

- Security data is written to the tags to allow or deny them to pass the security gates.
- A receipt may optionally be printed

Instructions and help are usually displayed on a touch screen which may be configured to suit individual library - or even site specific - requirements (supplier offerings vary). Some systems will allow the printing of advertisements or other messages on the receipt.

Libraries should remember the complex decisions that may be involved in issuing a library books. For example, is the book eligible for loan, is the customer "on stop", is the customer the right age to borrow that book or resource? The sophistication of the LMS in answering all of these questions is a good reason why this logic needs to be resident with LMS and not "outsourced" to the RFID solution.

If the LMS is in charge the question may be asked what happens when the LMS goes down. Clearly this **does** happen but nowadays, with much improved reliability of computer technology, it happens quite rarely and perhaps not frequently enough to warrant expensive parallel systems to "understudy" the LMS. It may make more sense for libraries to revert to manual methods for the one or two days a year when the system goes down and to pay for a robust support contract to keep the LMS running

reliably than to invest in understudy systems.

## RETURN OF BOOKS

Items may be returned in a similar way to issue but in most cases a borrower card is not required for a return. The operation is even simpler than issue:

- Borrowers place items on the reading table
- Items are checked by the exchange of SIP messages with the LMS
- Borrowers place returned items in bins or on shelves as instructed by the unit
- A receipt may optionally be printed

The system indicates that the item's tag has been read and recognized. This can be done by using a beep, a light or a message on the display.

When the system is first deployed there is a learning curve for both staff and customers. When there is a problem for example a book's tag doesn't read correctly, customers must be able to call on staff to sort out the problem.

## FINE / CHARGE PAYMENT

Another function that SIP and self-service may be required to provide is fine and charge payment. Fines will be generated and managed by the LMS, either at the point of issue or on return. Clients may be prevented from borrowing items because they have exceeded maximum charge limits. RFID suppliers have a number of solutions available to facilitate financial operations ranging from separate payment stations to integrated units supporting payment technologies as varied as

smart card and mobile phones through chip and pin to cash machines – with and without change facilities<sup>9</sup>.

Self-service issue and return are the most common reasons for deploying RFID in the library. Many libraries however have found that the next application delivers even more significant economic returns:

## AUTOMATIC SORTING

Depending on the level to which SIP has been implemented by an LMS supplier, returned items may be sorted into many different categories or indeed transported to different locations in the library, from a simple requirement to separate reserved items from the rest, through to complex sort and delivery operations for immediate shelving, or by just about any other required criteria. Self-return sorters are modular devices capable of extension to suit any library.

Typically,

- The borrower activates the return function via a touch screen
- Items are passed through a slot (resembling a letter box)
- RFID tags are read and checked to ensure:
  - it is an item belonging to the library
  - if it is a set, that it is complete
- SIP messages are exchanged with the LMS to determine the delivery location.
- Optionally a receipt is printed.

The system sorts the books using conveyors and bins. Staff may have to be on hand to monitor the system and to cope with any problems but the system should be expected to have the capacity to process all returned items without queues forming. Libraries should do some analysis of their peak volumes and ensure that their RFID solution can cope with these volumes.

## COMBINED ISSUE/RETURN

In many instances Issue and Return functions may operate on the same unit. Most suppliers will offer the flexibility to operate units selectively as “Issue only”, “Return only”, or “Issue and Return”.

## SELF-SERVICE/SELF-ISSUE/SELF-RETURN<sup>10</sup>

- Self-service/Self-issue/Self-return is by far the most popular application among adopters of RFID technology. Analysis of circulation figures from a growing number of RFID-enabled libraries suggests that some are now achieving up to 70-90% of their transactions being processed via self-service
- Levels of use appear to be more heavily influenced by the library’s commitment to self-service rather than by the actual devices used.
- Automated returns sorters can identify

items by collection, status or other SIP-defined categories and deliver them to a trolley, bin or shelf location as required.

- In addition, self-service may be deployed to provide out of hours service, or to facilitate lending at unstaffed locations.

## CONCLUSION

If budgets being tight, it is not cost-efficient for the library to use RFID tags only to replace the functions of barcode. A library should conduct a thorough evaluation in advance basing on the needs and characteristics of its services and collections to estimate the potential benefits of installing an RFID system by investigating the functions already developed by the industry before making the decision. By doing so, the failure risk can be lowered and many innovative applications of such a system may be created.

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