RFID SYSTEM : A BOON FOR LIBRARIANS

Faizul Nisha   Samar Iqbal Bakhshi   P M Naushad Ali

Abstract

Radio Frequency Identification Systems (RFID) are increasingly used in libraries for automation of repetitive work such as lending or returning of items. The ability of RFID (Radio Frequency IDentification) to read multiple tags at once and ability to read without line of site reduces repetitive tasks. RFID enables more rapid updating of the library database enabling improved availability and circulation. Libraries, schools, the government, and private sector businesses are adopting radio frequency identification tags, or RFIDs - a technology that can be used to pinpoint the physical location of whatever item the tags are embedded in. The present paper is an attempt to describe major features of RFID technology, its benefits over barcode system, basic components and optional components with their effect on library system. Authors describe in the article, RFID is a boon for librarians as It further highlights the key functions of RFID in libraries like shelf charging –discharging, reliability, high speed inventorying, automated materials handling etc. and disadvantages like high cost, accessibility to compromise, reader collision, tag collision, and lack of standards. The paper also discusses the recent developments in RFID Systems as well as next generation use of RFID. The paper throws light on RFID initiatives in India. At the end some recommendations regarding the implementation of RFID System in libraries have been listed.

Keywords : RFID, Components, Features, Initiatives

1.   Introduction

RFID technology has been in use for decades, initially in military applications, such as tracking material in rugged and fast-moving situations where barcodes could not be used.   RFID stands for Radio-Frequency IDentification. This technology is similar in concept to a cell phone. The RFID device serves the same purpose as a bar code or a magnetic strip on the back of a credit card or ATM card; it provides a unique identifier for that object, and, just as a bar code or magnetic strip must be scanned to get the information, the RFID device must be scanned to retrieve the identifying information. Libraries began using RFID systems to replace their electro-magnetic and bar code systems in the late 1990s. RFID automatically enables to collect product, place, time or transaction data without human intervention or error. The problem with today's library RFID systems is that the tags contain static information that can be relatively easily read by unauthorized tag readers. This allows for privacy issues described as "tracking" and "hotlisting." RFID works better than Barcodes as it allows information to be read by radio waves from a tag without requiring line of sight scanning and virtually simultaneous and instantaneous reading of multiple tags in the vicinity of the reader. Each tag can have a unique code that ultimately allows every tagged item to be individually accounted for find mis-shelved books rapidly, inventory entire collections quickly, ease branch rotation and weeding and enhance security.

2.   Applications of RFID

RFID tags come in a wide variety of shapes and sizes; they may be encased in a variety of materials :

- Animal tracking tags, inserted beneath the skin, can be rice-sized.
- Tags can be screw-shaped to identify trees or wooden items.
- Credit card shaped for use in access applications.
- The anti-theft hard plastic tags attached to merchandise in stores are also RFID tags.

3. Applications in Libraries

RFID (Radio Frequency Identification) is claimed to provide cost-effective solutions to many of the key issues facing most libraries :

- Annual stock taking
- Rapid checking that books are shelved in the correct area
- Searching for specific items using a scanner
- Self check-out of items
- Self-return of items
- Security
- Library membership cards

4. How RFID works

A reader typically contains a high frequency module (transmitter and receiver), a control unit and a coupling element to the transponder. In addition, many readers are fitted with an additional interface to enable it to forward the data received to another system (PC, robot control system,...).
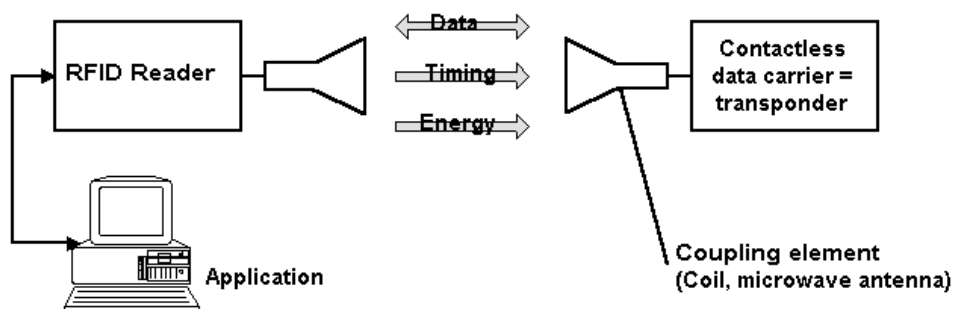
Picture: The reader and the transponder are the main components of every RFID system
(Source: http://RFID-handbook.com)

The transponder, which represents the actual data-carrying device of an RFID system, normally consists of a coupling element and an electronic microchip. When the transponder, which does not usually possess its own voltage supply (battery), is not within the response range of a reader it is totally passive. The transponder is only activated when it is within the response range of a reader. The power required to activate the transponder is supplied to the transponder through the coupling unit (contactless) as is the http://www.rfid-handbook.de/rfid/timing pulse and data.

5.   RFID System Components

A comprehensive RFID system has four components:

1.   RFID tags that are electronically programmed with unique information

2.   Readers or sensors to query the tags

3.   Antenna

4.   Server on which the software that interfaces with the integrated library software is   loaded.

6.   Tags

The heart of the system is the RFID tag, which can be fixed inside a book's back cover or directly onto CDs and videos. Also known as a *transponder*, the tag consists of an antenna and silicon chip encapsulated in glass or plastic (Want, 2004). The tags contain a very small amount of information. For example, many tags contain only a bar code number and security bit (128 bits) but some tags contain as much as 1,024 bits (Boss, 2003). Tags range in size from the size of a grain of rice to two inch squares depending on their application. Researchers are now working on tags as small as a speck of dust (Cavoukian, February 2004).

Tags can be passive, active or semi-active. An active tag contains some type of power source on the tag, whereas the passive tags rely on the radio signal sent by the reader for power. Most RFID applications today utilize passive tags because they are so much cheaper to manufacture. However, the lack of power poses significant restrictions on the tag's ability to perform computations and communicate with the reader. It must be within range of the reader to function. Semi-active tags are not yet commercially available but will use a battery to run the microchip's circuitry but not to communicate with the reader. Semi-active tags rely on capacitive coupling and carbon ink for the antennas rather than the traditional inductive coupling and silver or aluminum antenna used in passive tags (Collins, 2004). Tags operate over a range of frequencies. Passive tags can be low frequency (LF) or high frequency (HF). Most library applications use HF tags (Allied Business Intelligence [ABI], 2002).

Tags can be Read Only (RO), Write Once Read Many (WORM) or Read Write (RW) Boss, 2003). RO tags are preprogrammed with a unique number like a serial number (or perhaps eventually an ISBN number). WORM tags are preprogrammed but additional information can be added if space permits. RW tags can be updated dynamically. Most library applications use RW tags (Ward, 2004).

7.   Readers

RFID readers or receivers are composed of a radio frequency module, a control unit and an antenna to interrogate electronic tags via radio frequency (RF) communication (Sarma et al. 2002). The reader powers an antenna to generate an RF field. When a tag passes through the field, the information stored on the chip in the tag is interpreted by the reader and sent to the server, which, in turn, communicates with the integrated library system when the RFID system is interfaced with it (Boss 2004).

Readers in RFID library are used in the following ways (Boss 2003):

1. Conversion station: where library data is written to the tag

2. Staff workstation at circulation: used to charge and discharge library materials

3. Self check-out station: used to check out library materials without staff assistance

4. Self check-in station: used to check in library materials without staff assistance

5. Exit sensors: to verify that all material leaving the library has been checked out

6. Book-drop reader: used to automatically discharge library materials and reactivate security

7. Sorter and conveyor: automated system for returning material to proper area of library

8. Hand-held reader: used for inventorying and verifying that material is shelved correctly.

8. Antenna

The antenna produces radio signals to activate the tag and read and write data to it. Antennas are the channels between the tag and the reader, which controls the system's data acquisitions and communication. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually. Antennas can be built into a doorframe to receive tag data from person's things passing through the door.

9. Server

The server is the heart of some comprehensive RFID systems. It is the communications gateway among the various components (Boss, 2004). It receives the information from one or more of the readers and exchanges information with the circulation database. The server typically includes a transaction database so that reports can be produced.

Optional RFID system includes the following three components (Bibliotheca 2003):

i.   RFID Label Printer
ii. Handheld Reader
iii. External Book Return

10. Key Features of RFID in Libraries

The reliability of the system, its ease of operation, and the flexibility of tagging all kinds of media easily, are important criteria in choosing an RFID system. The main aim for today's libraries in adopting RFID is the need to increase efficiency and reduce cost. Automation and self-service can help libraries of all sizes achieve these aims, and RFID has the added advantage that it can also provide security for the range of different media offered in libraries. The technology can also improve circulation and inventory control, which helps allocate human and financial resources. This means that libraries can relieve their professional employees of routine work and operational tasks.

Few libraries use "smart" card, which is an RFID card with additional encryption, is an alternative to merely adding an RFID tag on staff and user identification cards (Boss 2004). Not only does that identify users for issue and return of library materials, but also for access to restricted areas or services. This

would make it possible to make it into a "debit" card, with value added upon pre-payment to the library and value subtracted when a user used a photocopier, printer, or other fee-based device, or wished to pay fines or fees.

11.   Self-charging/Discharging

The use of RFID reduces the amount of time required to perform circulation operations. This technology helps librarians eliminate valuable staff time spent scanning barcodes while checking out and checking in borrowed items. For the users, RFID speeds up the borrowing and return procedures. Library employees are released for more productive and interesting duties. Staff are relieved further when readers are installed in book drops.

12.   Reliability

The readers are highly reliable. Several vendors of RFID library systems claim an almost 100 percent detection rate using RFID tags (Boss 2004). Some RFID systems have an interface between the exit sensors and the circulation software to identify the items moving out of the library. Were a library user to leave the library and not be caught, the library would at least know what had been stolen. If the user card also has an RFID tag, the library will also be able to determine who removed the items without properly charging them.

Other RFID systems encode the circulation status on the RFID tag. This is done by designating a bit as the "theft" bit and turning it off at time of charge and on at time of discharge. If the material that has not been properly charged is taken past the exit gate sensors, an immediate alarm is triggered.

13.   High-Speed Inventorying

A unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand-held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information. Using wireless technology, it is possible not only to update the inventory, but also to identify items, which are out of proper order.

14.   Automated Materials Handling

Another advantage of RFID technology is automated materials handling. This includes conveyor and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts. This significantly reduces the amount of staff time required to ready materials for re-shelving.

15.   Demerits of RFID Systems

*   **High cost** : The major disadvantage of RFID technology is its cost. While the readers and gate sensors used to read the information typically cost around $2,000 to $3,500 each; and the tags cost $.40 to $.75 each.

*   **Accessibility to compromise** : It is possible to compromise an RFID system by wrapping the protected material in two to three layers of ordinary household foil to block the radio signal (Boss 2004). It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals. This requires knowledge of the technology and careful alignment.

- **Chances of Removal of exposed tags** : RFID tags are typically affixed to the inside back cover and are exposed for removal. This means that there would be problems when users become more familiar with the role of the tags (Boss 2004). In Indian libraries, it is a major challenge to keep the tags intact.

- **Exit gate sensor (Reader) problems** : While the short-range readers used for circulation charge and discharge and inventorying appear to read the tags 100 percent of the time (Boss 2004), the performance of the exit gate sensors is more problematic. They always don't read tags at up to twice the distance of the other readers.

- **User Privacy Concerns** : Privacy concerns associated with item-level tagging is another significant barrier to library use of RFID tags. The problem with today's library RFID system is that the tags contain static information that can be relatively easily read by unauthorized tag readers.

- **Reader collision** : The signal from one reader can interfere with the signal from another where coverage overlaps. This is called reader collision. One way to avoid the problem is to use a technique called time division multiple access, or TDMA.

- **Tag collision** : Another problem readers have is reading a lot of chips in the same field. Tag clash occurs when more than one chip reflects back a signal at the same time, confusing the reader.

- **Lack of Standard** : The tags used by library RFID vendors are not compatible even when they conform to the same standards because the current standards only seek electronic compatibility between tags and readers. The pattern of encoding information and the software that processes the information differs from vendor to vendor, therefore, a change from one vendor's system to the other would require retagging all items or modifying the software (Boss 2003)

16. RFID Initiatives in India

While there are over 500,000 RFID systems installed in warehouses and retail establishments worldwide, RFID systems are still relatively new in libraries. Most installations are small, primarily in branch libraries. The University of Connecticut Library; University of Nevada/Las Vegas Library, the Vienna Public Library in Austria, the Catholic University of Leuven in Belgium, and the National University of Singapore Library are using RFID systems.

The percolation of RFID technology in libraries in India is spreading, and thus far not less than 8-10 libraries are using it. Prominent among them include NCL, Pune; IISc, Bangalore, Bank of Baroda, Mumbai; University of Jammu, Jammu; Poona University, Pune; etc.

So far in India, only two University libraries have adopted the RFID system. Pune University (Jayakar library) has taken the lead in implementing RFID technology in libraries and second is Dhanvantri Library of Jammu University. At Pune University's Jayakar library, members don't return books to a librarian or register the books they borrow at a counter behind which the librarian sits. He or she simply places a smart card on one of the three "readers" or devices in the library and the books are automatically registered in his or her account. Half the 4.25 lakh documents, books and periodicals in the library have an electronic label that costs Rs 50 pasted on them. In addition, two electronically monitored antennae have been set up at the library's entrance and exit. If a book is unauthorisedly sneaked out of the library, a buzzer sounds at the entrance. To be sure, books can still be pilfered.

We can say, RFID is still in its infancy. The use of RFID throughout Indian libraries will take at least four to five years.   But consider the following:

The Chitale Dairy at Bhiwladi in Maharashtra's Sangli district has installed RFID to monitor the feeding patterns of cattle and bison. An electronic tag is attached to the neck of cattle for this purpose.

Pantaloon Retail India is in discussions with Wipro on introducing RFID at its Tarapore factory for the next two months. If the pilot project helps save costs, the retail major will give Wipro the go ahead for implementing the technology in phases, starting with its warehouse at Tarapore.

Nearly 45 colleges in Pune that fall under the three deemed universities or education trusts, including the R P Vidyapeeth, D Y Patil Prathisthan and Maharashtra Academy of Engineering, and the Baroda-based Babaria Institute of Technology, have introduced student identity RFID cards that allow students access to hostels and monitor their classroom attendance. Each student will swipe his card at a reader to record his attendance. Attendance data can be uploaded on the Internet and accessed by parents. For the hostel, a turnstile gate can be set up at which students will swipe cards. At the press of a button, the number of students there as well as visitors to the hostel can be found out.

NASSCOM 2005 added another feather to its cap by being the first in India to implement RFID enabled ID cards to track delegate behaviour during the conference. These RFID cards helped allow or restrict access to delegates as per their registration information.

On the IT front, Indian firms like Infosys, Patni, Cognizant, TCS and multinationals alike have teams working on RFID-enabled solutions and services. For instance, Patni is currently working with a few Wal-Mart suppliers on feasibility study and pilot projects to evaluate the benefits of RFID. LiBSUITE RFID is specially designed for Indian conditions. It is developed by Soft-AID Computers. It is a modular system and requires very less maintenance. The design is robust to withstand any working condition including dust. Components of LiBSUITE RFID systems include RFID Universal Station, Tags, Gate Antenna, and Stock Taking. Functional specifications of LiBSUITE include issue operation, return operation, tagging and Electronic Article Surveillance (used for detecting that no book is going out of the library without being scanned).

17.   RFID Implementation: Some suggestions

i.   The library community must monitor and shape the direction vendors and jobbers are taking with RFID. It is important for the library community to resist efforts that move RFID from its present proprietary ("closed") status to that of the RFID standards in the marketplace (the EPC standard developed by MIT's AutoID Center) - or that incorporate the use of marketplace tags with library-specific tags, a situation that could occur if the publishing industry adopts RFID. Also, it is especially critical for the library community to require effective, auditable security of RFID systems.

ii.   Library community conduct a comprehensive technology assessment of RFID as soon as possible to enable librarians to make the best possible decisions involving the implementation of this technology. Such a risk-benefit analysis would include an investigation of the potential privacy and civil liberties implications and the best methods to mitigate these harms.

iii.   Libraries should continue to protect privacy by ensuring that they are not seen as proponents of RFID before it can be safely deployed. Libraries should work to ensure that RFID products are manufactured and used according to well-established privacy principles.

iv.   The library must make public its policies and practices involving the use and maintenance of RFID systems, encompassing tags, readers, and the associated database(s).

v.   Signs should be posted at all facilities using RFID. The signs should inform the public that RFID technology is in use, the types of usage, and a statement of protection of privacy and how this technology differs from other information collection methods.

vi.   Only authorized personnel should have access to the RFID system.

vii. No personal information should be stored on the RFID tag.

viii. Preferably no static information should be contained on the tag (bar code, manufacturer number) that can be read by unauthorized readers.

18.   Conclusion

RFID technology promises to change our world. It has the capability of making our personal lives and our work lives in the library more convenient. However, every new technology comes at a cost. In order to remediate those costs, efforts must be undertaken to guide its development and implementation. Libraries should not yet implement RFID systems. Instead, libraries should be among the entities putting pressure on government and industry bodies to develop standards, public policy and best practices guidelines for its use. Libraries that choose to implement RFID technologies in advance of policy safeguards being put in place should take extra precautions to follow evolving best practices guidelines. Libraries should refuse to implement potentially unsafe RFID solutions simply. Finally, libraries must **be** outspoken in their public education efforts related to RFID. Not only because libraries are one of many industries who can benefit from the safe implementation of RFID systems, but also because RFID represents the start of a slippery slope to ever greater loss of control over our personal information because they are convenient.

19.   References

1.   BIBLIOTHECA RFID Library Systems AG (2003)"RFID Technology Overview". Available on www.bibliotheca-rfid.com.

2.   Boss. R. W. "RFID technology for libraries" [Monograph]. *Library Technology Reports* . November-December 2003.

3.   Boss. R. W. PLA Tech Notes (May 14, 2004) "RFID Technology for libraries". Available on www.ala.org/ala/pla/plapubs/technotes/rfidtechnology.htm

4.   Cavoukian, A(2004, June)."Guidelines for using RFID tags in Ontario public libraries.", Toronto, Ontario.

5.   Cavoukian, A.. (2004, February). "Tag, you're it: Privacy implications of radio frequency identification (RFID) technology". Toronto, Ontario.

6.   FAQ RFID Journal (Online Version 2004). Available on www.rfidjournal.com/article/articleview/207.

7.   Flagg, G. " Should libraries play tag with RFID?" *American Libraries 34(11), Chicago*: American Libraries*,* Dec.2003. p.69-71.

8.   Hesseldahl, A. (2004, July 29)." A hacker's guide to RFID". *Forbes.com.* Available on   http://www.forbes.com/home/commerce/2004/07/29/cx_ah_0729rfid.html.

9.   Koppel, T. (2004, March)." Standards in Libraries: What's Ahead: A Guide for Library Professionals About the Library Standards of Today and the Future". The Library Corporation. Available on http://www.tlcdelivers.com/tlc/pdf/standardswp.pdf

10. Sarma, E. S. Weis, S. A., Engels, D.W. (November 2002). "White paper: RFID systems, security & privacy implications." Cambridge, Massachusetts Institute of Technology, AUTO-ID Center.

11. Smart,L.J.(n.d.). "Considering RFID". Available on www.csupomona.edu/~ljsmart/draftarticle.doc

12. Ward, D.M. (2004, March). March: RFID Systems. *Computers in Libraries, 19-24.*

13. http://ncsi.iisc.ernet.in/pipermail/lis-forum/2004-November/001412.html

14. http://www.cilip.org.uk/interests/rfid/index.html.

15. http://www.privacyrights.org/ar/RFID-ALA.htm.

16. http://infoblog.infopeople.org/2004/08/rfid_and_libraries.php

17. http://www.rfid-handbook.de/rfid/timing pulse and data

18. http://www.libsuite.com

About Author

Ms. Faizul Nisha is a Research Scholar at Department of Library and Information Science, Aligarh Muslim University, Aligarh. She holds M.Sc (Zoology) and MLISc (Gold Medalist ,2004) from the same University.
E-Mail : momi_sonu@yahoo.co.in

Ms. Samar Iqbal Bakhshi holds B.Sc Mathematics from DDU, Gorakhpur University, Gorakhpur in 2003. She is Gold Medalist in MLISc(2005) from Aligarh Muslim University and pursuing research from the same university.
E-mail : bakhshi_samar2005@yahoo.com

Dr.Naushad Ali is presently Reader in Department of Library and Information Science, Aligarh Muslim University, Aligarh. He obtained his PhD from Lucknow University, Lucknow, Has over 9 years of teaching experience. His areas of interest are Information Management, Knowledge Management and IT Application in Libraries. He has published over 20 research articles in various journals and conference proceedings.
E-mail : pmnaushadali@yahoo.co.in