Development of RFID Interface for LMS: Solutions and Techniques

Manoj Kumar K, Geeta G Murjani, and Bansari M Patel
INFLIBNET Centre, Ahmedabad, Gujarat, India

perambra@gmail.com, gmdotcom2004@yahoo.co.in, bansari_17@yahoo.com

Abstract

Libraries, whether academic or public, are complex entities, having large collections and serving a huge clientele for their information needs. In order to meet the requirements of the academic scholars and faculty members, libraries are undergoing tremendous changes in terms of automation through modernization. The modernization of libraries is done on priority basis keeping in view of recent trends in technology and technological advancement. Sharing the information by using the latest wireless network technology such as Wi-Fi, Wireless LAN, Wi-Max, Bluetooth and Cellular Technology, WAP / WAP 2.0, WML, WMLScript, XHTML MP, WCSS / WAP CSS and RFID are predominantly becoming most sought after development platforms now. Leveraging this development in technology, specially designed LMS (Library Management System) facilitates to have effective management and automation of Library activities. RFID Technology enabled LMS helps in achieving the goal of completely automated library by saving manpower and time, reducing complexity of library operations and enhancing the security. The paper discusses the way of implementing RFID support with LMS and concentrates on the development of an interface based on SIP2 (Standard Interchange Protocol version 2) protocol, which is generally accepted as a standard for RFID Implementation in Libraries. This experiment was conducted in Information and Library Network (INFLIBNET), India with its Library Management Software, SOUL.

Keywords: RFID, SIP2, Library Automation, Library Software, INFLIBNET, Library, LMS, SOUL, ICT in Libraries, Wireless Libraries, Modernization of Libraries.

Introduction

Library Management System (LMS) is automated library software (Boss, 2004) that provides a variety of services to facilitate smooth functioning of all aspects of the library vis-à-vis collection management, cataloguing, classification, issue/return, usage tracking etc. and deals with various kinds of collections like books, periodicals, theses, serials, magazines, CD-ROMs and audio/video titles. With the help of the Library Management System, a library can maintain a database of all its content. The librarian can seamlessly manage content and track all information regarding lending and subscription. Other features include management of subscription base, membership cards, alerts for renewal and penalties.

INFLIBNET Center has developed Windows based Library Management Software ***"SOUL" (Software for University Libraries)*** (K, Murjani, & Patel, 2007), which provides total solution for Library Automation. INFLIBNET is an autonomous Inter-University Centre of the University Grants Commission (UGC), Govt. of India. INFLIBNET Centre is involved in modernizing university libraries in India and connecting them as well as information centers in the country through a nation-wide high-speed data network using the state-of-art technologies for the optimum utilization of information. SOUL is designed using Client-Server Architecture, which imparts extra strength to storage capacity, multiple access to single database, various levels of security, back up, and storage facilities etc. SOUL is accepted as user-friendly software in the academic sectors in India with more than 1350 installations, but still demands new features to meet the emerging trends in technology and standards by incorporating MARC 21, Unicode standards, SMS support, RFID compliance etc.

RFID (Radio Frequency IDentification) is an emerging wireless technology which has gained wide spread importance due to its vast applications in different areas of society. The term "RFID" describes a system that wirelessly transmits the identity of an item through radio waves and does not require any line-of-sight communication. Wireless data capture, transmission and transaction processing are facilitated by RFID.

RFID Rationale

A RFID system (Holloway, 2006), as the name implies, uses radio frequencies to transmit the unique identity of an item. Among the many available ways of identifying objects using RFID, the most used one is storage of unique ID or serial number of the item on the tag, known as transponder, which is a small microchip, attached with an antenna. The identification information stored on the tag is transmitted through antenna to a RFID Reader known as Transceiver. The radio waves received by the reader are converted into digital information so that it could be utilized by the software and further transactions could take place depending on the information received.

Remarkable benefits of using RFID are improved productivity, cost avoidance, decreased cycle time, taking costs out, reduced rework, reduced business risk & control of assets, improved security and service, improved utilization of resources, enhanced exemption management, etc. These benefits of RFID have led to its usage in the following areas (Hanson, 2006):

- Logistic & tracking in real time item location/item visibility & status, anti-theft/tamper evidence, authentication
- Automotive Industry for tracking and controlling major assemblies within a production plant
- Personal identification in access control, animal tagging, car immobilisers
- Payment systems which uses Road Toll, E-ticketing, mass transit ticketing
- Workflow processes for service/maintenance records, remote management, mobile data etc.
- Defense and aerospace industry for improving supply chain visibility and ensuring the authenticity of parts.
- Healthcare sector in patient operation, drug trials & clinical testing. Use of ePedigrees based on RFID to prevent the counterfeiting of prescription drugs.
- Movement of farm animals to assist with tracking issues when major animal diseases strike

- E-passports which store passport information with travel history and digital picture of the owner.

In Asia ("Asia under the spotlight," 2006) a lot of RFID activities are projected in the year 2007-2008, which includes RFID ticketing for 2008 Olympic games transport network, contact-less ticketing solution for Shanghai's Qi Zhong Tennis 2007, Shenzhen to adopt ICODE labels for 30000 public libraries, thousands of convenience stores for cashless transaction with one million *Smart Purse* cards in Thailand, etc. In addition to these activities, many Asian countries are aiming to roll-out ePassports or ID cards in the near future starting from Australia to Thailand, India to the Philippines, and New Zealand to Malaysia and Singapore and public transport system is based on RFID MIFARE in South Korea, and clinical train in health care sector.

Leveraging the RFID technology, IT industry also has tapped the potential of its use in many IT applications. Many short range and long-range applications are available in market for inventory control, product authentication, transport, animal identification, hospitals etc. In modern Libraries, functions of a library are modernized and automated using RFID technology. The automated functions, which are supported by RFID systems, include self-check system, inventory control, enhanced security etc. in addition to its normal activities.

RFID System Components

In general an RFID System (Ayre, 2004) is composed of the following four components as shown in Figure 1.

1. RFID tags (*also known as* transponders)
2. RFID readers (*also known as* transceivers)
3. RFID middleware
4. RFID software applications

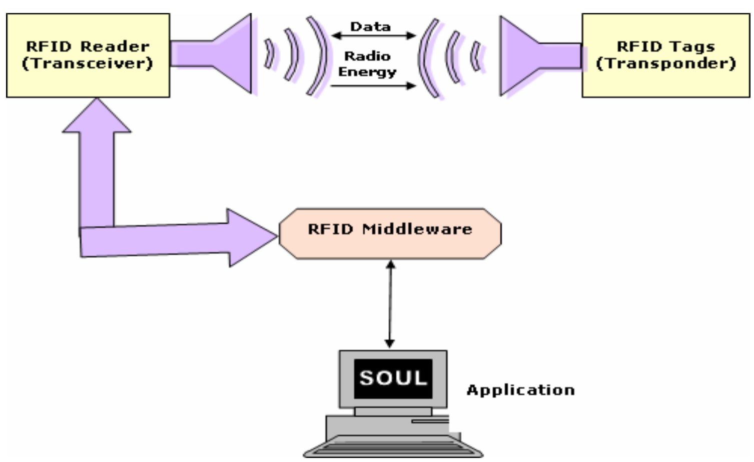

Figure 1: RFID System Components

Since wireless communication is involved between tags, readers and the application system, it is relevant to analyse the flow of data in an RFID system.

There are two basic methods for communication:

1) Close range, electromagnetic or inductive coupling.
2) Propagating electronic magnetic wave.

Inductive coupling (also called near field coupling) is used for short-range reading and propagating electromagnetic waves (also called for field coupling) are used for large-range reading. The structure of antenna plays a significant role in all the components of RFID system.

Both the RFID tags and readers have an antenna included in it. Generally, a reader passes three important things to the host computer based on the reading from the tag, viz the item Id, the reader's own ID and the time at which the tag is read.

The Antenna

An antenna is a transducer, an electronic component, designed to transmit or receive radio waves. The antenna functions for both the transmitter and receiver by radiating and collecting radio energy. For transmitter, it converts electrical signals to radio waves and for receiver it collects the radio waves and converts them into electrical signals.

Tags/Transponders

Tags, also known as *transponders,* are very small devices and contain a microchip with an antenna. Generally, the tags are placed on the item but in rare cases tags are also placed very near to the objects to be identified. Tags are flexible enough to store information and hence can be programmed to specific fields of information, such as an ID or serial number. A reader transmitting appropriate radio signals gets the reflected energy from the tag which in turn allows the tag to identify itself and its stored data. Tags can be typically classified according to its frequency, memory modes, memory size, type, and packaging. There are three basic types of tags from which appropriate one can be chosen based on the application for which tags are required:

Active Tags

Active Tags contain a battery used for running the microchip's circuitry and for broadcasting a signal to a reader. Typically it operates at 455 MHz, 915 MHz , 2.45 GHz or 5.8 GHz, as shown in Figure2, between 60 feet and 300 feet. These are usually used on large assets and such tags can always remain on alert or can be triggered when required.

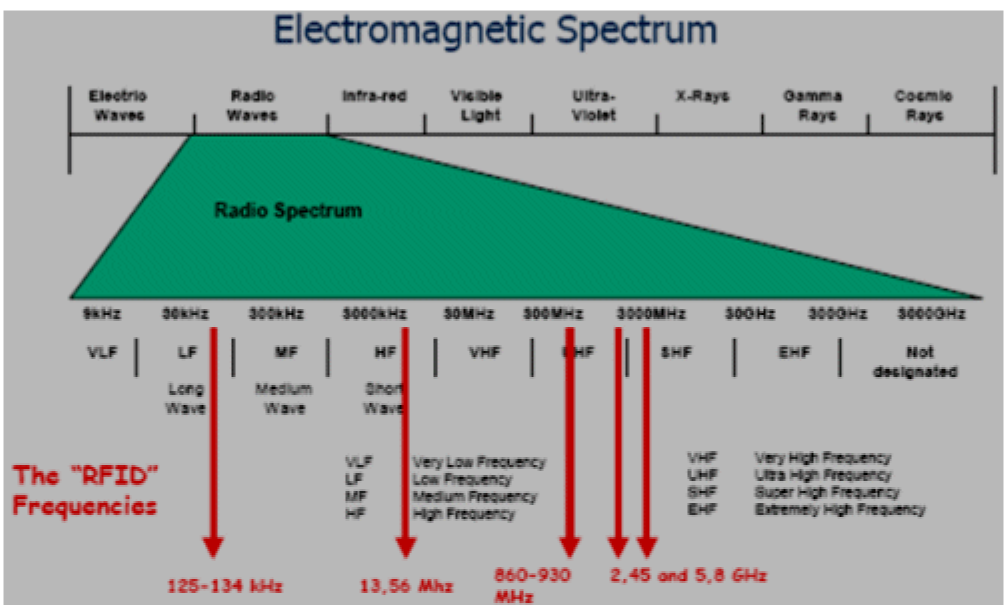

Figure 2: RFID Frequencies (Daniel, 2005)

Passive Tags

Unlike Active tags, Passive Tags do not have source for power viz. battery or transmitter. They draw power from the reader which reads the information from them and are comparatively cheaper then active tags. Passive tags do not require any maintenance and operate at low (125 KHz) frequency having read range less than 0.5m and high (13.56 MHz) frequency having read range approximately 1 meter. Most Library application use HF tags.

Semi-active Tags

Semi-active tags are a combination of both the active and passive tags and contain some properties from both the types of tags. Like active tags, they require a battery to run their chips circuitry and like passive tags they communicate by drawing power from the reader. Mostly semi-active Tags are in "sleep" mode and are awakened only when they receive a specific reader signal.

Reader

Reader is part of RFID hardware, required to read the stored data from the tags. A Reader receives and emits radio waves to carry out the above function and consists of one or more antenna. The reader passes the information retrieved from the tags to the computer system in digital format. There are many ways through which a RFID reader can communicate with tags. The most common one is inductive coupling in which tags at a closer range are read. In this method the antenna of the reader communicates with the tags antenna and creates a magnetic field. The tags draw energy from the produced field and use it to send radio waves back to the reader.

RFID in Libraries

Instead of a traditional library system, in which a librarian checks out a book, an RFID enabled Library would allow instantaneous lend and return of books, journals, serials, CD's, e-books etc and that too automatically. Without taking much time of library staff and user waiting in long queues, an authorized library member can just take the book, video or CD and check it out by himself. Automatic check-in is done, when the item is returned back. The central computer, which manages, and tracks all the lending and returning transactions in library, provides real-time knowledge of inventory. Improvements in tracking accuracy and time efficiency are achieved by providing automatic alerts to library staff for delayed returns or missing library items. In case of any special issues, like overdue items pending to be returned, crossing of the maximum number of items allowed to be granted etc., the system can even refrain from lending new items until the past ones are cleared. RFID usage in libraries also aids in finding misplaced books quickly and streamlining the inventory process along with maximization of floor space with frequently requested items.

Uses of RFID in Libraries

Many of the RFID solutions for library automation include following general functions, as shown in Figure 3 (Boss, 2004):

1. Tagging
2. Check in/out Service
3. Self Check in/out
4. Anti-Theft Detection
5. Book Drop
6. Shelf Management

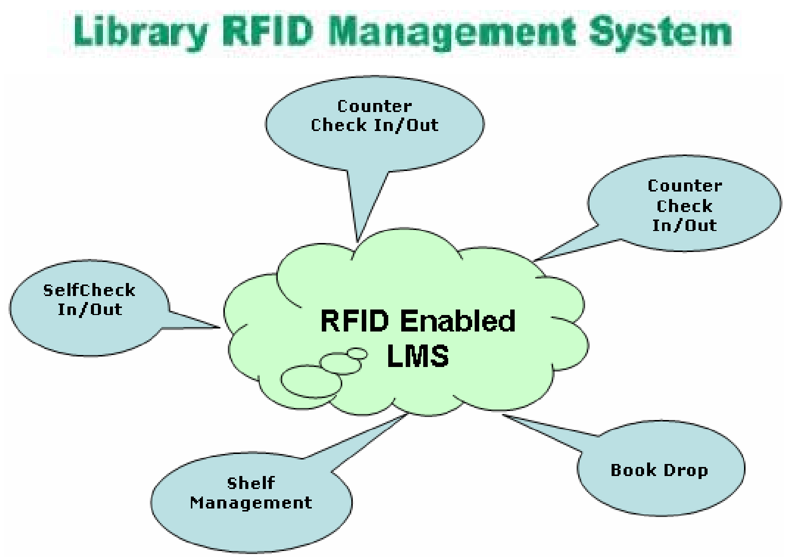

Figure 3: Uses of RFID in LMS

Description

Tagging: In tagging process, tags are created with a unique id of books. Accession number is used as the identity in many cases and it is written on the chip of the tag.

Checking-out: In the check-out process, the books to be checked-out of the library are placed on the area where it can be read. Prior to it, the validity of a member card is to be confirmed. The check out function updates the library database and simultaneously the theft detection system on the tag is deactivated. If the facility for receipt is provided, then a receipt is printed out containing confirming details of borrowed material and return date.

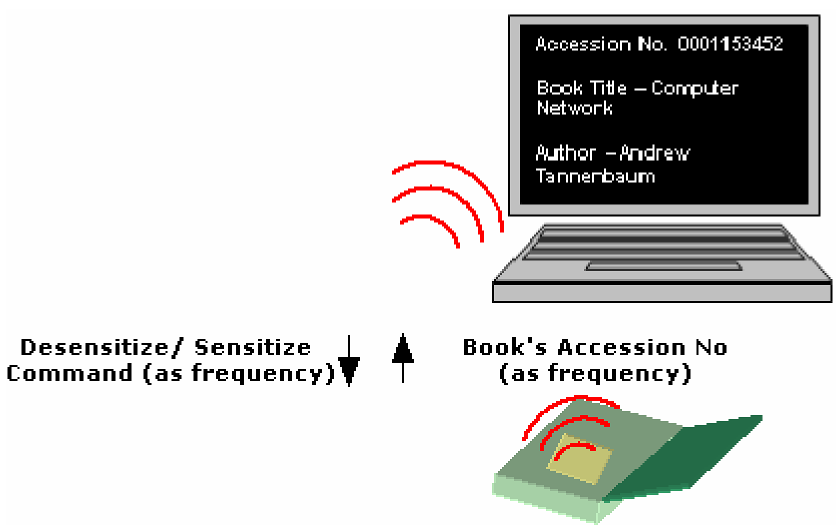

Figure 4: Check In/Out in RFID Enabled LMS

Checking-in: In the check-in process, the books returned are put on the area of RFID reader. The check-in function will read the tag and update the Library database, as shown in Figure 4. At the same time, it will also automatically activate the theft detection system on the tag label. The user will be provided with information on check-in as printed slip.

SelfCheck in/out: (LSmart Solutions, n.d.) SelfCheck in/out is a self-service station on which the borrower checks-out the books from the library independently. It is an interactive station like ATM which first prompts the patron to enter his/her library card. The corresponding function in the application checks the validity of the member card and then prompts to place the books on the deck of the Self Check Station, as shown in Figure 5. The Library database is automatically updated when the books are checked-out and, simultaneously the theft detection system on the tag label of those books is de-activated so that the books can be smoothly carried out of the library through the security gate. A receipt containing details of the issued books along with their return dates is issued to the borrower.

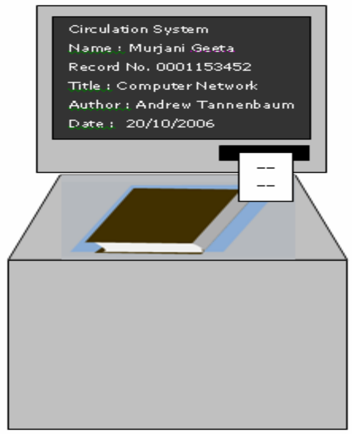

Figure 5: SelfCheck System in RFID Enabled LMS

Anti-Theft Detection*:* Electronic security gates are used for Anti-Theft Detection with two or more pedestals placed with overlapping protection zones for additional security. Any item that has not been checked-out in the library will be detected as it goes past these gates and it will produce security alarms in the building. (See Figure 6.)

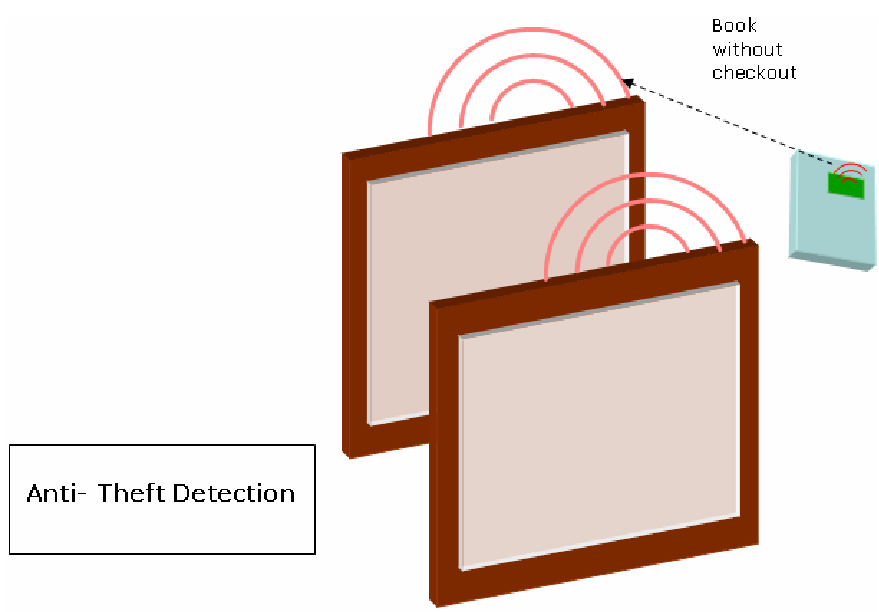

Figure 6: Anti-Theft Detection System in RFID Enabled LMS

Book-Drop: In the Book-Drop process, the books are returned through the Book Drop stations, which are placed at a suitable location in the library as shown in Figure 7. The tag labels are automatically read and the corresponding application function immediately updates both, the member record and the library database. Also the theft detection systems on the tag labels are simultaneously activated. To facilitate the return of books within 24 hours a day and that too without the visiting the library, book-drop stations can be placed at various locations in the institute. This allows the borrowers to return books at their convenience.

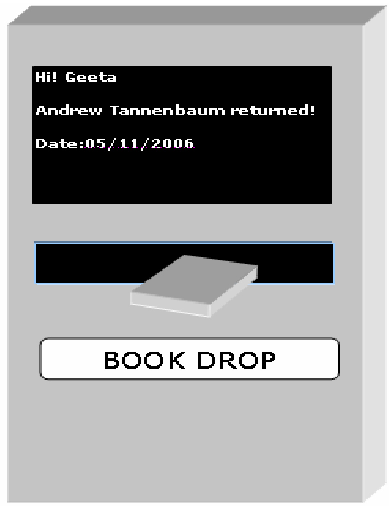

Figure 7: Book-Drop Facility in RFID Enabled LMS

Shelf Management: Special Handheld Inventory wands can be used for rapid and accurate Inventory controls on shelves. Tag labels attached on the books can be read in very short duration. If any book is placed on a wrong shelf, then a Position error, as shown in Figure 8, is reported for that book as the wand moves across it. Also the book labels read help in inventory control by reporting missed books.

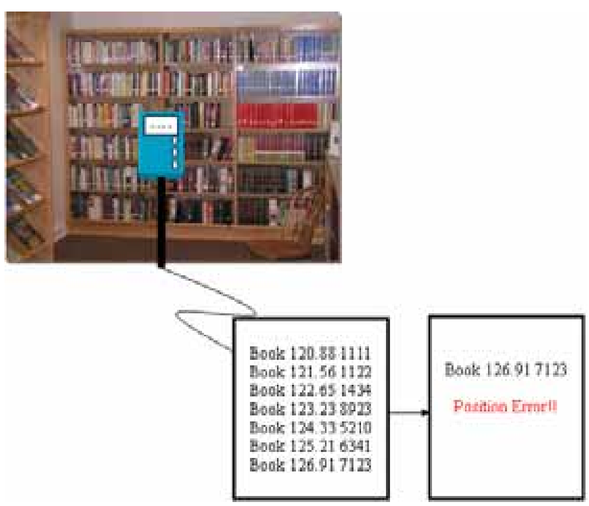

Figure 8: Shelf Management in RFID Enabled LMS

What Protocol Does RFID Use?

A **communications protocol** is the set of standard rules for data representation, signaling, authentication and error detection required to send information over a communications channel. It is the "language" of the network: a method by which two dissimilar systems can communicate.

TCP/IP is a protocol which runs over a network RFID system also uses protocols for communication between RFID hardware and LMS. The protocols are used to exchange and interpret messages required for automation of Library activities. The protocols used by RFID in Libraries are SIP2 and NCIP. SIP2 stands for ***Standard Interchange Protocol version 2*** (Marsolek & Egeberg, 1998) and is a proprietary protocol developed by 3M. Though there are no ISO approved standards for Implementing RFID in Libraries but SIP2 is almost accepted as a standard protocol by library software developers. NCIP stands for *NISO Circulation Interchange Protocol* and was approved by NISO (National Information Standards Organization) in 2002. Feasibility of Library software based on NCIP is yet to be explored.

RFID based on SIP2 Protocol

As mentioned above, there are various protocols used for the implementation of RFID. **SIP2** Protocol is considered to be the standard protocol for implementing RFID in libraries. Thus so far, no standardization has been approved by the ISO but the standardization process on its way. The implementation discussed below is compatible with the RFID Systems that support SIP2 Protocol with SC (SelfCheck System) and ACS (Automated Circulation Software) (Junwei, 2004).

- **SIP -** Standard Interchange Protocol

  The Standard Interchange Protocol, an industry standard for data communication between the SC and ACS
- **SIP2**

  Version 2.00 of Standard Interchange Protocol
- **SC**

  A SelfCheck system or a SelfCheck system emulator
- **ACS** –

  ACS automatically assists a library in the management of its circulation

SelfCheck system is a self-service library system used by users to check out their own library items. It interacts with the circulation system to complete the loan transactions. In essence, it emulates the library item checkout procedures normally conducted at the circulation desk.

How the SelfCheck System Works

This section gives a general overview of the SelfCheck system. When a user places a library card in the SelfCheck system, a magnetic or optical scanner is activated that reads the bar code. The barcode information is then sent to the ACS, using SIP2 protocol, for verification. If the ACS shows that the user is approved, SelfCheck system leads the user through the checkout process. The user then places the item, with its barcode, within range of the optical scanner. The item bar code is sent to the ACS, again using SIP2 protocol. If the ACS verifies that the item can be circulated, the item is charged out, SelfCheck system desensitizes the tag label and a data due receipt is printed. (LSmart Solutions, n.d.)

SIP2 Message Communication

All communication between the SelfCheck system and the ACS is initiated by the SelfCheck system. The ACS only responds to SelfCheck system messages, it does not initiate messages. For each message sent from SelfCheck system, there is a required response message from the ACS. Each message pair is independent of previous or following message pairs. For instance, it is not required for the SC to send a User Status Request message or User Information Request message before a Checkout Message. The Checkout Message contains all the information that is needed for the ACS to perform a Checkout operation. It is intended that each protocol message pair be independent of any other protocol message pair. Patron in the message names stands for users who have a library card and who issue items from library.

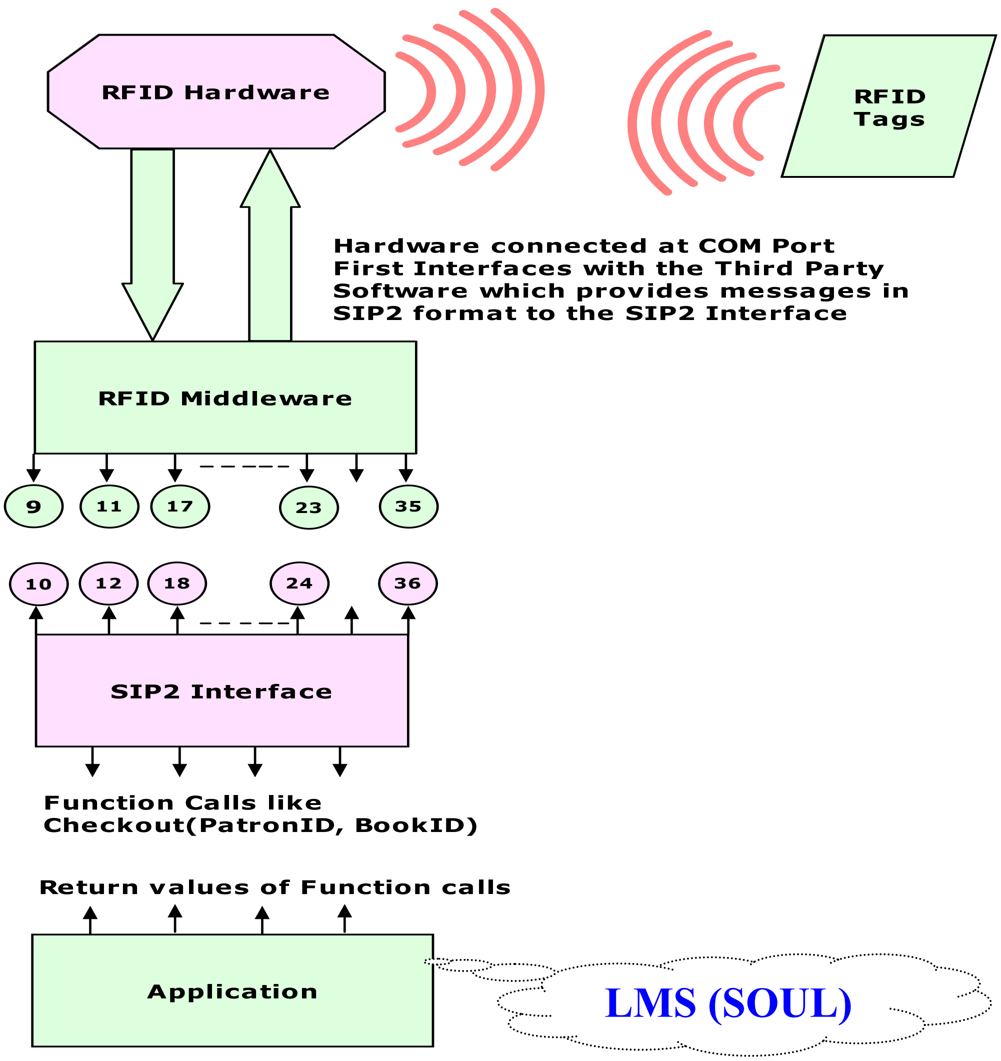

Figure 9: Design Model for RFID Interface

SIP2 Interface for SOUL

The RFID Hardware reads the data stored on the RFID tags. This data includes the unique identity of the item and also information regarding the functions to be carried out. All these pieces of information are sent to the RFID Middleware, which constructs a message based on the received information. The RFID Middleware, in turn sends this message to the RFID Interface (i.e. SIP2 Interface for SOUL) which interprets the message and decodes it using the given logic. An example is given in Figure 9 for better understanding.

Suppose a check out function for a book having accession number as 0001153452 is to be carried out. The RFID Hardware reads the accession no. on the RFID tags placed on the corresponding book and sends this identity information along with the member id whose identity has already been established via smart card reader or barcode reader depending on the library configurations. The Hardware also passes information regarding the function to be carried out (i.e. check out in this case) along with its various configuration settings. This information when passed to RFID Middleware, a request message corresponding to the Check out function viz Message 11 is generated and sent to SIP2 Interface.

The check out message format is:

11<SC renewal policy><no block><transaction date><nb due date><institution id><patron identifier><item identifier><terminal password><patron password><item properties><fee acknowledged><cancel>

The details of the message fields are shown in Table 1.

Table 1: Details of Message Fields

Field	ID	Format
SC renewal policy		1-char, fixed-length required field: Y or N.
no block		1-char, fixed-length required field: Y or N
transaction date		18-char, fixed-length required field: YYYYMMDDZZZZHHMMSS
nb due date		18-char, fixed-length required field: YYYYMMDDZZZZHHMMSS
institution id	AO	variable-length required field
patron identifier	AA	variable-length required field
item identifier	AB	variable-length required field
terminal password	AC	variable-length required field
item properties	CH	variable-length required field
patron password	AD	variable-length optional field
fee acknowledged	BO	1-char, optional field: Y or N
cancel	BI	1-char, optional field: Y or N

The message sent from RFID Hardware i.e. SC (SelfCheck System) is of the form:

11YN19960212   10051419960212   100514AO|AA104000000105|

AB000000000005792|AC|AY3AZEDB7<CR>

The description of above example is as follows:

(11)(Renewals OK)(Not no block)(02/12/1996/10:05:14a.m.Local)(Same date)(No id)

(104000000105)(000000000005792)(No term password)(Sequence Number 3)(Checksum)(CR)

The SIP2 Interface interprets the message in the manner described in the description of the example. Depending upon the requirement of the message, the interface further calls the functions in the Application i.e. SOUL Library Management Software with proper arguments. The Application executes these functions and updates the Library Database as required. After executing all the required functions, the application sends the return values of these functions to the SIP2 Interface. The SIP2 Interface constructs a Response message based on the return values of these functions. The response message generated is sent to the RFID Middleware which on interpreting the message gives appropriate commands to the RFID Hardware. In the above example, if the return values indicate a successful check out, then the RFID Middleware sends commands to the RFID Hardware for desensitizing the theft detection system of the tag under consideration. This would allow smooth passage of the item from the security gates. This is the manner in which the RFID Support is made available to LMS by developing a SIP2 Interface between the RFID Middleware and LMS software. RFID Hardware is vendor dependent and the vendor provides supporting RFID Middleware.

Messages between Self-Check System to ACS

There are several independent message pairs between Self Check and ACS. SelfCheck always initiates the communications hence SelfCheck messages are called *Request* and ACS always replies to the request messages hence ACS messages are called *Response* messages. The message pairs are shown in Table 2 (3M Standard Interchange Protocol, 1998).

Table 2: Message Pairs

Sr.No	SelfCheck Messages	ACS Messages
1	Login, Message 93	Login Response, Message 94
2	SC Status, Message 99	ACS Status, Message 98
3	Request ACS Resend, Message 97 Resend last Message	Resend last Message Request SC Resend, Message 96
4	Patron Status Request, Message 23	Patron Status Response, Message 24
5	Patron Information Message, Message 63	Patron Information Response, Message 64
6	Block Patron, Message 01	Patron Status Response, Message 24
7	Patron Enable, Message 25	Patron Enable Response, Message 38
8	Item Information, Message 17	Item Information Response, Message 18
9	Checkout, Message 11	Checkout Response, Message 12
10	Checkin, Message 09	Checkin Response, Message 10
11	Fee Paid Message, Message 37	Fee Paid Response, Message 38
12	End Patron Session, Message 35	End Session Response, Message 36

Communications Mechanisms

The SelfCheck system can be connected to the ACS in several ways. The connection can be made over a serial line, or can be implemented using sockets or TELNET with TCP/IP.

Serial connection

The SelfCheck system can be connected via serial cable to the ACS (K et al., 2007). There may or may not be a terminal server physically stationed between the SelfCheck system and the ACS. The SelfCheck system configuration options allow selection of the typical serial connection parameters - baud rate, character size, parity, stop bits, flow control, and communications port. The ACS must provide software that accepts characters (which, taken together, constitute a SIP message) from the serial connection.

TELNET connection

Another way to establish a connection between the SelfCheck system and the ACS is to attach the SelfCheck system to a TCP/IP network to which the ACS is also attached. SelfCheck system configuration options allow selection of the necessary parameters for SelfCheck system to be able to establish a telnet connection to the host computer on which the ACS application resides (IP address and port) as well as to login to that computer system. The host computer environment that is associated with the user-id (login) assigned to the SelfCheck system should be configured to initialize the ACS application so it is ready to receive SIP messages on successful login by the SelfCheck system. In client/server terminology, SelfCheck system acts as a client and the ACS is a server. Once the TELNET connection has been established, the SelfCheck system and the ACS use it as a medium for passing text messages back and forth. The SelfCheck system does not act as a terminal, but does follow the rules of TELNET communications.

Socket connection

With the release of latest SelfCheck system software, it is now also possible to establish a socket connection to the SelfCheck system, allowing the connection to the ACS to be over a LAN but eliminating the need for a TELNET session and its remote login. Standard Protocol Version 2.00 includes a Login message which can be used to login to an ACS server program once the socket connection has been established. Similar to TELNET, SelfCheck system configuration options allow selection of the necessary parameters to establish a socket connection (IP address and/or host name, and port). When used, the Login message is the first message sent over the connection; it contains a user name and password which establish the SelfCheck system as a valid user of the service provided by the ACS at that port. Succeeding data sent over the connection is, again, more ASCII SIP messages. Again, in this type of arrangement, SelfCheck system is a client and the ACS is a server.

The messages as shown in above examples arrive at the serial port, socket connection etc. The data that arrives is read and the message is decoded by checking the first two characters that arrive. For example if the first two characters are **23** then it is understood that the message is Patron *Status Request Message* and the characters following the first two are then decoded accordingly. The message after decoding is responded back by the ACS to the SelfCheck System. Example it will send response by sending *Patron Status Response Message* having first two characters as **24** to the SelfCheck System.

VB.NET does not provide native support for COM Port Communication through inbuilt controls. But dynamic link libraries (dll) are available for same on Internet. Using these API's, COM Port communication is handled. The message arriving is decoded using the logic given below:

```
String msg = objRs232.recieve(data)
String first2chars = msg.Substring(0,2)
switch(first2chars)
case "93"
 Login message.
 Construct Login response Message, 94
case  "99"
SC Status.
Construct ACS Status Message, 98
case "97"
Request ACS Resend Message.
Last Message sent by ACS is resend to SelfCheck System but without sequence number.
case "23"
User Status Request Message.
Construct User Status Response Message, 24
……………………………….
End switch
objRs232.send(Message)
```

Note: It is assumed that the software installing RFID in the system provides the corresponding SIP2 messages at the configured COM port of a computer.

Conclusion

Libraries are going through major technological changes with the introduction of Bio-metric, RFID, Wi-Fi, Smartcard, CCTV, Internet and various Web technologies. RFID applications are emerging in various sectors due to its technological prowess and easiness. Automation and modernization of libraries using RFID based application is getting momentum throughout the world. Though there are vendor specific solutions for its implementation, a global standard for a common solution has not yet being evolved. SIP2 protocol, even though developed by a proprietary company 3M, it is being tested for its operational and technical feasibility as a standard in many libraries for its effective implementation. Middleware based on the solution depicted in this paper is under development. The SIP2 interface developed for integrating RFID with SOUL software is a general solution, which can be adopted for any LMS software with slight modifications. Introduction of such a solution in the University libraries and other academic libraries in the country will boost the modernization activities to turn the library to a fully user-centered automated library.

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Biographies

Mr Manoj Kumar K is Acting Director at INFLIBNET Centre which is an autonomous Inter University Centre of University Grants Commission, Govt of India. He joined the Centre as a Scientist-D (Computer Science) in 2004. He has more than 15 years of wide experience in IT including 6 years at Indian Institute of Management, Kozhikode (IIMK). He holds Bachelors in Chemistry and Master of Computer Applications. He is involved in setting up of state-of-the-art IT infrastructure in IIMK from scratch and faculty to various training programs. He has remarkable experience as a faculty in various National and International workshops in application of Digital technologies in libraries and learning systems.

Ms. Geeta Murjani was selected for TCS as a software engineer when she was doing final year in Bachelor of Engineering in Information Technology from Dharamsinh Desai University (DDU), Nadiad, Gujarat and currently doing project industrial training in INFLIBNET. Prior to B.E, she did her Diploma in Information Technology. She has a strong inclination towards research in the field of Information Technology that includes the convergence of all technologies.

Ms. Bansari Patel is a Final year student of the Bachelor of Engineering in Information Technology from Dharamsinh Desai University (DDU), Nadiad and doing her project industrial training in INFLIBNET, Ahmedabad, India. Prior to B.E. She has done her Diploma in Information Technology. She has strong affiliation towards developing software based on Network, Communication, Wireless etc.