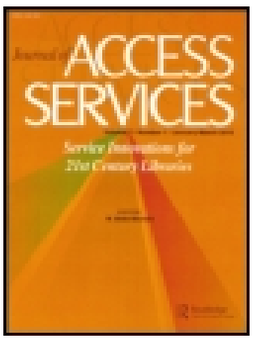

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RFID Technology in the Library Environment

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ABSTRACT. After surveying historical and current uses of Radio Frequency Identification (RFID) systems, the authors discuss the various technological components necessary for implementing RFID in libraries. The paper concludes with a discussion of nine issues that librarians should consider before purchasing an RFID system. doi:10.1300/J204v03n02_03

KEYWORDS. Radio frequency identification, RFID, security, privacy, self-check-out

INTRODUCTION

Historical and Current Uses of RFID

Radio frequency identification (RFID) is one of many products falling under the umbrella name "automatic identification" or "auto-id."

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These technologies are used to help machines identify objects. Other auto-id technologies include bar codes, smart cards, voice recognition, and optical character recognition.

RFID technology has been around for about 60 years. The first major application was during World War II when the Allied Forces used it to identify friendly aircraft in an effort known as IFF (Identify Friend or Foe). In the 1980s, the technology went public where it was used for everything from tracking cows and pets to triggering equipment down oil wells. The most common applications include tracking goods in the supply chain, tracking assets, tracking parts moving to a manufacturing production line, security (including controlling access to buildings and networks), and automated payment systems that let customers pay for items without using cash. Current uses of the technology suggest its flexibility in diverse situations. Dog owners have used RFID tags to identify their pets rather than the traditional tattoo. Hewlett Packard has used RFID tags to track runners at the Boston Marathon. Legoland Billund, an amusement park in Denmark, uses RFID technology to help parents keep track of their children while at the park. The Vatican is currently tagging its 1.6 million volume book and manuscript collection with RFID microchips. RFID technology is used to combat counterfeiting in sports memorabilia and to track baggage at airports; and the world's largest retailer, Wal-Mart, requested that its top 300 suppliers tag all their pallets and cases in 2005. In a similar move, Target, third largest retailer in the U.S., set a 2007 deadline for its top vendors to implement RFID. The Department of Defense required its 45,000 suppliers to be tagged in 2005. Libraries are the largest institutions using item-level RFID tagging and as such are on the cutting edge of the developing technology for this unique application of RFID.

RFID IN LIBRARIES

RFID technology offers libraries many solutions that enhance efficiency in circulation and security, thereby freeing up staff to provide increased information and intellectual support to patrons. Other advantages of RFID are that the frequency of repetitive stress injuries decreases, materials are back on the shelf faster, patrons enjoy higher levels of privacy because they can self-check-out their own materials, and time and money can be saved using RFID inventory systems.

One disadvantage of which libraries should be mindful is that RFID does not provide fail-safe security and is certainly not worth the invest-

ment if being implemented primarily for that reason. Tags can be ripped off materials, media are a problem to tag, and readers do not always read tags on all of the materials going out of the library. Other obstacles to the technology are the high cost, its lack of standards, and privacy issues.

So how does RFID technology work in libraries? Components of an RFID library system include tags; conversion units; readers such as self-check units, automated return systems and inventory-taking equipment, security gates, and a server or docking station software.

Tags

Tags contain an antenna and a chip with a capacity of at least 64 bits, that can be encoded with data the library selects. They are in the high frequency range of 13.56 MHz and are available as WORM, read, and read/write. WORM is "write once read many times" and indicates that a tag can be programmed one time only. Read tags come with pre-programmed information, usually some type of item identification, and cannot be written to. Read/write tags can be written to many times and are the most frequent choice for libraries. Most vendors claim a minimum of 100,000 transactions before a tag may need to be replaced. Other tag features include anti-theft and anti-collision properties. The anti-collision feature allows more than one item to be checked out or in at the same time, as opposed to bar codes which, because they require line-of-sight for material processing, can handle only one item at a time. The anti-theft feature, referred to as the security bit, is sensitized and desensitized during the check-out/check-in process and provides a level of security for the materials. Tags developed for libraries are passive, that is, they do not contain batteries and are activated by proximity to radio waves from a reader. Tags can withstand dirt and scratches and can be scanned from distances of up to two feet. Item-level tags can cost anywhere from 40 to 85 cents each and represent the most costly part of the RFID system for libraries. Plastic covers for tags or bookplates, onto which the library's name or logo can be placed, enhance the security of the tags and individualize them.

Because tags cannot be read through metal or water, tagging media like CDs and DVDs requires special solutions. Vendors approach this challenge in a variety of ways. Some offer special circular tags that fit around the inside of the diskette. These "media tags" can cost up to $1.50 each. The problem with media tags is that all CDs and DVDs are not equal, and it is possible that the tag may cover a portion of what is

encoded on the disk. Other vendor options for media include special lock boxes with tags or a separate distribution and security system.

Conversion Units

Conversion units are used to copy barcode data to an RFID tag during the material conversion stage of the RFID installation. These units can be purchased or rented, are portable for easy movement around the library, and fit in the aisle between stacks. The type of equipment you purchase will influence the conversion plan. For example, a combined self-check conversion machine would make it possible to bypass a formal conversion process altogether. One option is that conversion takes place as patrons check out materials, thus the most used items in the collection will receive the fastest conversion. After a set period of time, it is possible to run a report to see what remains to be tagged and develop a staff workflow to accomplish it. Conversion units can be rented by some vendors for approximately $250/week or purchased from $2,500 to $5,000.

Readers

Readers come in various forms. They can be hand-held, mounted, desktop, freestanding (like security gates), desktop, or installed in the return bins. Many libraries currently use security systems like tattle-tape with their security gates. Libraries should be aware that if RFID is being implemented with security in mind, these gates would need to be replaced. Security gates can cost $3,500-$6,000 and bookdrop readers can cost around $2,500.

Self-Check-Out Readers. We are all accustomed to using self-service in many different environments like grocery stores, retail establishments, and ATMs, so library self-check is not a big leap for library patrons. Basically, the self-check process desensitizes the security bit and updates the status of the material in the library's circulation system. Self-check-out units are by far the most popular of RFID solutions for libraries and provide immediate improvement in service and quality of experience for library patrons; RFID libraries report that anywhere from 40 to 90% of their check-out has moved to self-check. These units also provide patrons with a greater degree of privacy since only the patron handles the material during check-out.

Self-Check-In Readers. These readers check the material back into the library's catalogue and re-sensitize the anti-theft feature. Readers

for check-in can be installed as book returns throughout the library. Automated book returns are available and have the capacity to sort returned materials into sorting bins, thereby getting the materials back on the shelves faster. The prices of these readers, whether for check-in or check-out can be as much as $18,000-$22,000.

Inventory-Taking Equipment

Inventory wands are hand-held devices used to scan materials for library shelf maintenance including weeding, finding lost or misplaced materials, and inventorying or counting the collections. Some have screens which are hard to read; others offer a separate unit like a PDA that has to be held or worn on the wrist but provides a better viewing area for the user. Scanners that work with both RFID tags and bar codes are available and desirable for use during conversion or for libraries wishing to convert only part of their collection to RFID. Costs for inventory-taking equipment typically run from $2,500 to $4,500.

Security Gates

Though RFID security gates look very similar to the standard gates many libraries already have in place, the internal technology is different. For certain RFID systems, security gates emit a sound if the material has not been properly checked out.

Servers/Docking Stations

In order to manage the communication between the various components of the RFID system, a library may choose to use either a server or a docking station (the docking station involves increasing the amount of software in the readers). Basically, the server or docking station software receives communication from the reader(s) and exchanges information with the library's circulation database. Whichever way a library decides to go, it will be using SIP2, Standard Interchange Protocol, which manages the communication between the RFID system and the library's Integrated Library System (ILS). The server can be a very expensive part of the solution, often costing as much as $15,000, with much of this cost being for the software. Keep in mind that the costs for the various part of the RFID solution are coming down gradually, so it is important to check with vendors to get accurate pricing.

Standards

The International Organization for Standardization (ISO) is the organization that sets the technical operating standards for how readers and tags communicate. ISO 18000-3 tags, developed specifically for item-level tagging, have recently entered the marketplace. This standard establishes RFID-specific communication protocols at 13.56 MHz. The standards for these tags improve the ability to read a variety of vendor tags with one reader. However, vendors can customize their tags by adding proprietary protocols to the tags. The impact of these proprietary protocols is that they limit interoperability of RFID systems. This is an issue of which libraries need to be aware in researching RFID for their library. It would be advisable for libraries that interact frequently with each other to jointly select the RFID system that meets their needs. For the present, that is the only way to ensure interoperability between institutions.

Privacy

Privacy advocates voice concerns that RFID technology will allow for uncontrolled snooping, like satellite tracking of library patrons and the materials they check out. Some fears of "snooping" are based on the belief that the tags on library materials contain patron information. Privacy advocates recommend that only information on the barcode be programmed to the tag. Where this is done, there is no user or patron information programmed to the tag. In terms of tracking the material through to the patron, the link between the borrower and the borrowed material is maintained in the circulation module of the automated library system and is broken when the material is returned. However, if libraries implement smart cards (RFID chips on patron cards), then the privacy of cardholders could be at greater risk.

Others fear that RFID tags can be scanned outside the library environment. Though multitag readers are a technological possibility, so far they have not been developed expressly for the library marketplace. However, as Molnar (2004) pointed out at a recent ALA program on RFID, current readers can be programmed to read specific tags. To do this successfully requires that the snooper places the reader where it will gather effective information. A reader too distant from the target material would read all materials in the range. The snooper must also know what titles he/she is looking for. If tags contain only the barcode number

then the snooper can *hotlist* or put together a list of barcodes and titles he/she is looking for.

Molnar (2004) suggests that the best way to protect patrons currently is to encrypt and password the data on the tag. Because encrypting has different meanings for different vendors, he suggests that libraries understand exactly what kind of encrypting the vendor will be providing. For more on Molnar's perspective on privacy, see Molnar and Wagner's paper, "Privacy and Security in Library RFID–Issues, Practices and Architectures." Another feature of tags that libraries need to understand is that tags can contain a static identifier that is burned on at the time of manufacture. According to some, this persistent identifier enables tracking via hotlisting.

Several organizations are involved in raising awareness of the privacy issues around RFID including the ACLU, Electronic Frontier Foundation, Center for Democracy and Technology, and ALA. The attached bibliography contains references that discuss the various positions of the advocates around privacy issues.

Libraries should be proactive about privacy issues by educating the communities they serve. Adopting a privacy policy that is posted in the library is one way to keep your patrons aware of the steps you are taking to protect their rights. A couple of good sources to consult for guidelines on the privacy issues and policies for your library are: Berkeley Public Library's "Best Practices for RFID" and "Guidelines for Using RFID Tags in Ontario Public Libraries."

Getting Started

Implementing an RFID system requires a library to assess their processes and to target those processes where RFID would be appropriate. Lists of questions to guide the assessment process have already been developed and are attached in the bibliography (see Laura Smart's "Making Sense of RFID"). Another approach to considering this technology in your library is to take a look at the processes in your library from the patron's point of view. For the patron, everything in the library is pretty much centralized, that is, all activities go through the front desk. According to Kern and Nauer in their article, "Implementing RFID in Libraries for Process Automation," RFID systems allow the library to decentralize these processes so that reconfiguring the physical space of the library may be an option to consider. This paper provides suggestions about space reallocation based on an RFID system being in place.

NINE ISSUES LIBRARIANS SHOULD CONSIDER

1. *Workflow issues surrounding the technology*. Do you need that $200,000 book sorter? Do you need this technology? Will it make your library run more smoothly? Follow the life of a book, for example, and compare it with the pieces of RFID technology. What pieces do you feel would make it easier to handle the material?
2. *Cost of tags*. The cost of tags will not be coming down anytime soon; however, the costs of other pieces of the technology puzzle will most likely come down. Tags tend to be the most expensive part though, depending on your collection size. Keep in mind that just because Wal-Mart and the Department of Defense are requiring their vendors to use RFID tags does not mean the cost for library tags will come down. They are most likely on a different frequency which makes it a different type of tag altogether.
3. *Barcodes or no barcodes?* Libraries need to consider whether they are going to take out all of their barcodes once they convert to RFID. There are good reasons on both sides of the argument, but remember that without a barcode number on an item, you are depending on your RFID system to correctly identify it. Some vendors now incorporate barcode numbers into bookplates which cover the RFID tag.
4. *What sort of information are you going to keep on the tag?* Potentially, the more information you store on the tag, the longer it will take to transmit the data. Also ask vendors about encryption of data. This will help allay fears about privacy concerns.
5. *How are you going to determine Return on Investment (ROI)?* Does the RFID system you are investing in also fit with the long-term goals for your institution? No long-term studies of ROI have been done but some things to consider are: cost of software, hardware, overhead costs, costs of salaries while converting (if some of your staff have to be pulled from normal duties to do conversion). There is more to consider where cost is concerned than just the cost of the RFID system alone. A year after implementation, look at the productivity of the staff: has it gone up? Has it gone down? This is one way to determine ROI. Check out the ROI Laundry List from Laura Smart's "Making Sense of RFID."
6. *Privacy issues for patrons and staff.* Are you going to incorporate tags on library cards for patrons? Most libraries have chosen not to do this. Make sure you communicate with both patrons and staff about the privacy policies of the library and how infor-

mation is to be used. You will probably need to explain how RFID works, and what type of information will be stored on the tags. Are you going to incorporate encryption of data?

7. *Are you going to use the RFID system as a security measure as well?* If you decide to use the security features of RFID, it most likely means replacing your existing security gates. The technology in the security gates that work with traditional tattle-tape is different from the security portion of the technology that is incorporated into RFID tags. When asked whether it would be easier to gut the security gates and replace the technology inside or to replace the gates altogether, most vendors agree that replacing them altogether is less expensive.
8. *Confirm with vendor that your library systems and RFID systems will work together smoothly*. All RFID vendors comply with the SIP2 protocol which allows your ILS (integrated library system) and the RFID system to communicate; however, it might need some tweaking. Also, keep in mind that equipment will need to be maintained after installation. As standards change, hardware and software may need upgrading.
9. *Where are you going to get the money for the technology?* Since this technology can be fairly expensive, who do you have to convince that this is the right direction for your library, and how are you going to do that?

CONCLUSION

RFID is a technology that offers many advantages to libraries by creating time saving process management efficiencies, thus enabling staff to provide more value-added services to patrons. It also provides the patron with self-service check-in and check-out options. According to Jim Lichtenberg, another speaker at last year's ALA RFID panel, RFID stands with other cutting-edge technologies being developed in nanotechnology and biotechnology. These advances are not going away; they are only going to become more prevalent. We are probably in the early-adapter stage of RFID in libraries, where many of the kinks and issues are still to be worked out; but for Lichtenberg, like many others, it is just a matter of time before these problems are resolved. Only when the major issues of privacy and security are addressed by both librarians and vendors will solutions be found.

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