Introduction

It's an interesting time to be writing an issue devoted to RFID. So much has changed for libraries in the last decade. Ten years ago, it seemed like RFID was poised to take off and become a standard piece of library technology. But standards were slow to develop, and e-books were not. While libraries waited for RFID standards to develop, the iPad and Kindle emerged. As a result, libraries are struggling more with DRM, discovery interfaces, and patron authentication systems than with new technologies focused on their physical material.

Today, RFID systems are nothing more than glorified barcodes largely because libraries think that storing only the barcode on the tag is the best way to ensure patron privacy and because the ILS (integrated library system) doesn't support doing much with the tag besides reading the barcode anyway.

To make financial sense, libraries must use RFID more expansively and expansion relies on taking advantage of the new standard. Existing and new systems will have to migrate to the new standard to ensure vendor interoperability and interoperability between libraries. To protect their investment in RFID, libraries need to insist that vendors comply with the new standards to ensure their systems are interoperable with any vendor's hardware.

RFID could be a powerful technology that could change how libraries deal with physical material as well as leverage digital technologies to offer new services. RFID tags will soon be readable by smartphones, but to take advantage, libraries will need to develop new, patron-centric RFID applications.

The fertile ground for RFID adoption is in moving beyond RFID-as-barcode. It may or may not happen. My hope in writing this issue is that libraries will understand how hobbled our use of RFID in libraries is today. If we, as an industry, choose to invest further in this technology, we need to extend the use of RFID beyond circulation and security to resource sharing, materials handling, technical services, and beyond— into wholly new ways that will delight our patrons.

Acknowledgments

for these past several weeks. I think RIFD is an interesting topic, but there are more important things in life than RFID, and being a loving and attentive partner is certainly one of them. Thanks for your patience.

Executive Summary

RFID (radio frequency identification) tags have been used in libraries since 1999, when the National Library of Singapore installed the first system.[1] RFID tags, like barcodes, are used to uniquely identify library material. A barcode tag has the barcode number imprinted on the tag, and the barcode scanner reads that number using optical technology. With RFID, much more information can be stored on the tag, and the tag data is read via radio technology instead of optical technology. Whereas barcode scanners require line of sight to operate, RFID readers just need to be able to detect the tag. This means the reader needs to be within 18 to 20 inches of the tag, but the tag need not be visible (e.g., it can be inside the book).

The last time *Library Technology Reports* dedicated an issue to the topic of RFID, libraries were one of the few markets getting involved with the technology. According to Richard Boss, the author of that 2003 issue, "more than 500,000 RFID systems [were] installed in warehouses and retail establishments worldwide" and fewer than 200 were installed in libraries.[2] Libraries were a small player at that time, but they were one of the few players in the RFID market.

The worldwide RFID marketplace has changed markedly since 2003. RFID tags are used for toll payment and in supply chain systems to identify pallets and containers. They are used to track animals in the wild and patients in hospitals. RFID tags are used to control access, to immobilize vehicles, and to secure nuclear material. A huge market is asset management, where RFID tags are used to keep track of laptops, projectors, and other valuable equipment owned by an organization. RFID technology is used in aerospace, agriculture, apparel, construction, defense, logistics, medical, manufacturing, oil and gas, pharmaceuticals, and more.[3]

Today, RFID spending exceeds $5.85 billion worldwide,[4] and the technology is used in virtually every industry. However, RFID adoption in libraries has not seen this type of explosion. NXP, manufacturer of the integrated circuits that are part of nearly every library RFID tag, reports that some 3,000 libraries worldwide have implemented RFID. So, while libraries were among the first to get involved with RFID, libraries haven't gone very far with it since 2003.

In fact, most of the library RFID components (tags, readers, software) are essentially the same today as they were in 2003. There have been some improvements in the quality of the products offered, but there isn't much difference when it comes to functionality. The vendors providing RFID solutions are also largely the same, although some of the smaller players have disappeared and some have merged.

Between 2003 and today, digital technology has changed the nature of the library collection everywhere. Virtually every library has increased the size of its electronic resources while the size of physical collections has remained flat. RFID is a technology applicable only to physical books, CDs, and DVDs. Many libraries are reluctant to make a big investment in an expensive technology that is potentially only relevant to their physical collections.

Another reason libraries have been reluctant to embrace RFID is the lack of standards. With RFID, standards are a critical issue. The lack of standards has inhibited the adoption of RFID technology. [5] Standards act as a warranty on the library's investment in RFID. Without standards, RFID is a more risky investment. Standards eliminate vendor lock-in and allow for interoperability across different vendors' solutions. With vendor interoperability, libraries can buy their RFID components from any vendor with the expectation that everything will work together.

Standards lead to library and ILS interoperability as well. With library interoperability, libraries can read each other's RFID tags, making resource sharing and interlibrary loan (ILL) transactions more secure and simpler. ILS interoperability will allow libraries to switch from one ILS to another without having to worry that their RFID components will stop working.

To achieve vendor, library, and ILS interoperability, many standards have to fall into place. Some are there, but we still need more.

In the library market, libraries were able to

"Early RFID implementers are at considerable risk because of the lack of interoperability of proprietary vendor systems. As RFID providers and libraries adopt tags with the data model recommended in this recommended practice, true interoperability that allows libraries to procure the tags, hardware, and software from independent providers and distributors to use with all tags can become a reality. The data model outlined in this document is an essential first step. This model is a key precursor to a world in which a library can procure tags from different vendors, merge collections containing tags from different vendors, and, for the purposes of interlibrary loan, read the tags on items belonging to other libraries."

—NISO RFID Revision Working Group, *RFID in U.S. Libraries, Recommended Practice of the National Information Standards Organization*, NISO RP-6-2012 (Baltimore, MD: NISO, March 2012), v, www.niso.org/apps/group_public/download .php/8269/RP-6-2012_RFID-in_US_Libraries.pdf.

purchase ISO Standard RFID tags as early as 2003. Specifically, ISO 18000-3 made it possible to purchase RFID tags that wouldn't be rendered obsolete by subsequent developments in RFID. But the availability of ISO tags is only one small piece of the standards puzzle.

In an RFID system, tags contain data. In most cases, 1,024 bytes of data can be encoded into memory on the tag. The RFID reader reads the tag, but in order to do so, the reader needs to know what data elements are being used and how the data has been encoded. A data profile is what defines the elements and how they are encoded. In 2011, ISO finalized ISO 28560, which is a standard composed of three parts. Part 1 defines the data elements to be used on the tag, and the other two parts define alternate encoding methods. In March 2012, NISO established the US Data Profile[6] based on ISO 28560-2 (parts 1 and 2). This represents a very large piece of the puzzle. But there's more.

The RFID reader passes the data captured from the tags to another application. In library RFID systems, the reader usually acts as the conduit for getting the information from the tag and sending it to the ILS. Sometimes the information is used by an RFID application (e.g., inventory management module, weeding application), but it very often needs to communicate with the ILS.

SIP2 is the de facto standard for interfacing with the ILS.[7] Thus, an RFID reader is probably using the SIP2 protocol when it reads the information on the tag and passes it to the ILS. Another important protocol for ILS communication is NCIP2. Both SIP2 and NCIP2 primarily address circulation functions. So, when the RFID system is doing circulation tasks (check-in, check-out, renewals), these two protocols provide another important piece of the standardization puzzle.

RFID can be used for weeding, inventorying, ILL, materials handling, and possibly even for providing enhanced content to patrons using RFID-enabled smartphones. But in order to develop these new library RFID applications, we need to be able to interface in more ways with the ILS. In other words, SIP2 and NCIP2 are not sufficient.

SIP3 was recently released by 3M.[8] It provides a bit more functionality, but it is still far from being the solution for handling all the ILS communications libraries need in order to leverage RFID technology. The good news is that Book Industry Communication (BIC), a UK organization sponsored by booksellers, publishers, library professionals, corporations, and the British Library, has developed a framework intended to provide a roadmap for building upon the existing protocols to support development of additional functionality for library RFID systems.

The BIC Library Communications Framework (BLCF) helps identify the areas where new protocols and functionality are needed and provides guidelines for developing those protocols and functions in a way that remains standardized across the library industry.[9] Rather than having each RFID vendor develop its own inventory application (for example), development according to the BLCF will help standardize all RFID inventory applications so that vendor interoperability and ILS interoperability can continue to be assured. So far, this is a UK project, but US libraries would certainly benefit by getting involved.

The BLCF can guide development of additional protocols or serve as a roadmap for expanding upon existing protocols (e.g., SIP4 or NCIP3) so that we can do more with the ILS without veering off into proprietary solutions.

With the US Data Profile finalized, libraries are at a crossroads. Now is the time to push vendors to adhere to the new US Data Profile to ensure vendor and library interoperability. Widespread adoption of the US Data Profile is important for libraries. It is a big step closer to interoperability.

It is also time to think creatively about what else libraries can do with RFID tags. This will require new protocols for communicating with the ILS and development of new functions. Partnering with libraries in the United Kingdom may be the quickest way to make progress in this area.

My hope is that readers of this issue will come to understand how library RFID fits into the larger worldwide RFID and library context and—for libraries opting to use RFID—understand what needs to be done to exploit it so that it functions as the new technology it is and less like the old technology it has thus far replaced.

Notes

1. Connie K. Haley, Kathleen Degnan, and Kathleen Haefliger, "Library RFID Technology Update," December 9, 2008, https://sites.google.com/site/chaley102/Home/library-rfid-technology-update. Some argue that the University of Central Lancashire began a pilot a year earlier.
2. Richard Boss, "RFID Technology for Libraries," *Library Technology Reports* 39, no. 6 (November–December 2003): 16.
3. For information about the range of industries using RFID, see "RFID Business Applications," *RFID Journal* website, www.rfidjournal.com/article/view/1334/1; B. Craig, J. H. Lee, J. Anderson, H. Tsai, Y. Liu, and J. Shuler, "Integration of ARG_US RFID and DOE TRANSCOM, US Department of Energy Decision and Information Services, www.dis.anl.gov/pubs/70368.pdf; and RFIDTags.com, www.rfidtags.com.
4. Raghu Das and Peter Harrop, *RFID Forecasts, Players and Opportunities 2011–2012* (Cambridge, MA: IDTechEx, 2011), www.idtechex.com/research/reports/rfid_forecasts_players_and_opportunities_2011_2021_000250.asp.

5. May Tajima, "The Role of Technology Standardization in RFID Adoption: The Pharmaceutical Context," *International Journal of IT Standards and Standardization Research* 10, no. 1 (January–June 2012): 49.

6. The US Data Profile is available in NISO RFID Revision Working Group, RFID in U.*S. Libraries, Recommended Practice of the National Information Standards Organization*, NISO RP-6-2012 (Baltimore, MD: NISO, March 2012), www.niso.org/apps/group_public/download.php/8269/RP-6-2012_RFID-in_US_Libraries.pdf.

7. The SIP2 protocol is available in "3M Standard Interchange Protocol," version 2.00, document revision 2.10, updated September 17, 1998, http://multimedia.mmm.com/mws/mediawebserver.dyn?dddddd NLXpsdyHedrHeddd4LYP0DDDDC-.

8. See "SIP 3.0 Ready for Implementation," at author's blog, http://galecia.com/blogs/lori-ayre/sip-30-ready-implementation.

9. For more information about the BIC Library Communications Framework (BLCF), see "Library Interoperability Standards: Data Communication Framework for Library Systems," www.bic.org.uk/e4libraries/16/INTEROPERABILITY-STANDARDS.