Chapter 14

Wireless Tracking in the Library: Benefits, Threats, and Responsibilities

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Introduction

Libraries began using RFID systems to replace their electromagnetic and bar code systems in the late 1990s. Approximately 130 libraries in North America are using RFID systems, but hundreds more are considering it.[2] The primary cost impediment is the price of each individual tag. Today, tags cost approximately 75 cents, but prices continue to fall.

However, privacy concerns associated with item-level tagging are additional impediments to libraries' use of RFID tags. The problem with today's library RFID systems is that the tags

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contain static information that can be relatively easily read by unauthorized tag readers, allowing for privacy issues described as "tracking" and "hotlisting."

Tracking refers to the ability to follow the movement of a book (or person carrying the book) by "correlating multiple observations of the book's bar code"[3] or RFID tag. Hotlisting refers to the process of building a database of books and their associated tag numbers (the hotlist) and then using an unauthorized reader to determine who is checking out items on the hotlist.

Current standards (ISO 15693) apply to container-level tagging used in supply chain applications and do not address problems of tracking and hotlisting. Next-generation tags (ISO 18000) are designed for item-level tagging. The newer tags are capable of resolving many of the privacy problems of today's tags. However, no library RFID products using the new standard are currently available.

Libraries implementing RFID systems today are using tags unsuited for item-level tagging, and the cost of upgrading to newer tags when they become available is well beyond the reach of most library budgets.

This chapter addresses many of the specific issues and privacy concerns associated with RFID technology in libraries and suggests best practices in RFID-implementation for librarians. Finally, we explore the larger responsibilities of libraries in regards to RFID, public policy, privacy, and the changing world of technology.

RFID System Components and Their Effects in Libraries

An RFID system consists of three components: the tag, the reader, and the application that makes use of the data read on the tag.

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[2] Molnar, D, Wagner, DA (2004, October). Privacy and security in library RFID: Issues, practices and architectures. Retrieved March 25, 2005, from www.cs.berkeley.edu/~dmolnar/library.pdf.

[3] Ibid., 2.

Tag

Also known as a *transponder*, the tag consists of an antenna and silicon chip encapsulated in glass or plastic.[4] 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 of information.[5] Tags range in size from the size of a grain of rice to 2-inch squares, depending on their application. Researchers are now working on tags as small as a speck of dust.[6]

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 use 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, which are not yet commercially available, 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.

Tags operate over a range of frequencies. Passive tags can be low frequency (LF) or high frequency (HF). LF tags operate at 125kHz, are relatively expensive, and have a low read range (less than 0.5 meters). HF tags operate at 13.56MHz, have a longer read range (approximately 1 meter), and are less expensive than LF tags. Most library applications use HF tags.[7]

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[4] Want, R (2004, January). RFID: A key to automating everything. *Scientific American, 290(1), 56-66.* Retrieved July 9, 2004, from MasterFILE Premier database.

[5] Boss, RW (2003). RFID technology for libraries [Monograph]. *Library Technology Reports, November-December 2003.*

[6] Cavoukian, A, Ph.D (2004, February). Tag, you're it: Privacy implications of radio frequency identification (RFID) technology. Toronto, Ontario: Information and Privacy Commissioner.

[7] Allied Business Intelligence (2002). *RFID white paper.* Oyster Bay, New York.

Tags can be read only (RO), write once read many (WORM), or read write (RW).[8] 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. Sometimes space on the RW tags is locked where permanent data is kept and the rest of the tag is writable. Most library applications use RW tags.[9]

Reader

According to Sarma et al., 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. Many also include an interface that communicates with an application (such as the library's circulation system).[10]

Readers can be handheld or mounted in strategic locations to ensure they can read the tags as the tags pass through an "interrogation zone." The interrogation zone is the area within which a reader can read the tag. The size of the interrogation zone varies depending on the type of tag and the power of the reader. Passive tags, with shorter read ranges, tend to operate within a smaller interrogation zone.[11] Most RFID readers in libraries can read tags up to 16 inches away.[12]

Readers in library RFID systems are used in the following eight ways:

- Conversion station. Where library data is written to the tags

- Staff workstation at circulation. Used to check in and check out materials.

- Patron self-checkout station. Used to check out books without staff assistance.

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[8] Ibid., 5.

[9] Ward, DM (2004, March). March: RFID Systems. *Computers in Libraries, 19-24.*

[10] Sarma, ES, Weis, SA, Engels. DW (2002, November). *White paper: RFID systems, security & privacy implications.* Cambridge, MA: Massachusetts Institute of Technology, AUTO-ID Center.

[11] Ibid., 10.

[12] Ibid., 5.

- Exit sensors. Verify that all books leaving the library have been checked out.

- Patron self-check-in station. Used to check in books without staff assistance.

- Bookdrop reader. Checks in books when patrons drop them in the bookdrop.

- Sorter. Automated system for returning books to proper area of library.

- Portable reader. Handheld reader for inventorying and verifying that items are shelved correctly.[13]

Application

Once the reader reads the tag, the information is passed on to an "application" that makes use of the information. Examples of library and nonlibrary applications and their uses fall into at least six categories:

- Access control (keyless entry)

- Asset tracking (self-check-in and self-checkout)

- Asset tagging and identification (inventory and shelving)

- Authentication (counterfeit prevention)

- Point-of-sale (POS) (FastTrak)

- Supply chain management (SCM) (tracking of containers, pallets, or individual items from manufacturer to retailer)

RFID is most pervasive in the supply chain management (SCM) market. ABI reports that by 2007, SCM and asset management applications will account for more than 70 percent of all transponder (tag) shipments. [14] In the SCM market, items are tracked by pallet or container, not by individual item. Once the individual items are removed from the pallet, they are no longer tagged.

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[13] Ibid., 5.

[14] Ibid., 7.

In contrast, library applications require that each individual item contain a tag that uniquely identifies the item (book, CD, DVD, etc). The tag contains some amount of static data (bar code number, manufacturer ID number) that is permanently affixed to the library item. This information is conveyed, via reader, to the library's security, circulation, and inventory applications.

RFID Standards

The electromagnetic spectrum on which RFID resides is regulated by local governmental bodies. Global standards "define the most efficient platform on which an industry can operate and advance".[15] The International Organization for Standardization (ISO) and EPCglobal have been very active in developing RFID standards. The AutoID Center and its commercial offshoot, EPCglobal, have also defined specifications and standards. Because most commercial applications, including library applications, use the HF, the discussion of standards is limited to HF standards.

There are two ISO standards pertinent to library RFID systems. The current standard, ISO 15693, was not designed for the item-level tracking done in libraries. Yet most library RFID tags follow this standard. ISO 15693 was designed for supply chain applications. It defines the physical characteristics, air interface, and communication protocol for RFID cards. In August 2004, a new standard, ISO 18000, designed for item-level tagging was published. It will allow for more secure communications between tag and reader.

Library RFID applications must be able to interface with the library's integrated library systems (ILS). The SIP2 protocol has made it possible for RFID products and library automation products to exchange information. Over the years, shortcomings have been identified in SIP2 and the standard has been diluted as vendors modify the protocol to suit their needs.

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[15] R. Moroz Ltd. (2004, July). Understanding Radio Frequency Identification (RFID) (Passive RFID). Markham, Ontario: R. Moroz Ltd. Retrieved August 4, 2004 from www.rmoroz.com/rfid.html.

To address the shortcomings of SIP2, the National Information Standards Organization (NISO) convened a "standards development group with the mission of designing a protocol that would encourage interoperability among disparate circulation, interlibrary loan, self-service, and related applications." The outcome of this group was the National Circulation Interchange Protocol (NCIP). NCIP was approved by NISO in 2002. No library systems vendor has yet fully implemented it.[16]

RFID in U.S. Libraries

Penetration

Richard Boss reported that fewer than 200 RFID systems had been installed in libraries worldwide as of the middle of 2003. David Molnar (Molnar, 2004) reported that more than 130 libraries were using RFID in North America alone. As the cost of RFID tags comes down, more and more libraries are taking a closer look at the technology as a way to save staff time, reduce personnel costs, reduce staff injuries, and improve security and inventory control.

Over the past two years, increasing numbers of library conference presentations have been devoted to RFID. At the American Library Association's (ALA's) Mid-Winter Conference in San Diego, one RFID session was held. At ALA Annual in Orlando, two sessions were held. In 2003, six RFID vendors were listed on the exhibitor list for the ALA Annual Conference. By 2004, there were 13 RFID vendors at Annual.

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[16] 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. Retrieved August 5, 2004, from www.tlcdelivers.com/tlc/pdf/standardswp.pdf.

Library Problems Addressed by RFID

Libraries are suffering from budget shortfalls as never before. With cuts to state and local governments, it is difficult for libraries to remain staffed and open. RFID is seen as a way to address the staff shortages by increasing the number of circulations that can be processed with less staff.

Self-check systems have become very popular with both patrons and staff. RFID self-check systems allow patrons to check in or check out several books at a time. Self-check systems reduce the number of staff needed at the circulation desk.

With RFID-enabled tools, inventory-related tasks can be done in a fraction of the time that it takes with bar code readers. A whole shelf of books can be read with one sweep of the portable reader, which then reports which books are missing or mis-shelved. For archives handling sensitive materials, the ability to inventory items without handling them is an additional benefit.

Sorting can be accomplished automatically with RFID. For a book that is dropped into the book drop, the reader reads the tag and uses the automatic sorting system to return the book to the shelves, the stacks, or the hold area.

Reduction of repetitive stress injuries (RSIs) among staff is another reason libraries are converting to RFID system. The repetitive motion associated with checking out books using optical scanners is believed to be more problematic than with RFID enabled scanners. It is still too early to determine whether RFID systems reduce the incidences of RSI injuries.

Security is another aspect of library operations that may be greatly improved with RFID-based security systems. Rather than purchasing additional tags for security, libraries can use a single tag for identifying items and securing them. As patrons leave the library, the tags are read to ensure that the item has been checked out. Librarians also report that they can more easily retrieve lost or hidden items using the portable readers. At the session "Tiny Tracker: The Use of RFID Technology by Libraries and Booksellers." Karen Saunders of Santa Clara City Library reported at that many DVDs were being hidden by patrons for their own use later. Using the RFID reader, staff located these lost items and returned them to circulation.

The possibity of blocking the tag from being read by using foil or by removing the tag puts into question whether RFID is truly the best approach for library security.[17] In addition, readers are already being developed that are capable of scrambling the data on tags.[18]

Cost of Implementing RFID System in Libraries

Boss (2003) estimates the cost of implementing an RFID system for a library with 40,000 items at $70,000; for a library with 100,000 items, the cost would be $166,000. However, these estimates are probably high, given that costs are continuing to fall for items such as tags (now down to 20 to 75 cents each from 85 cents) and servers (now below $5,000 from an estimated $15,000).

The actual cost to any library will depend on which RFID modules the library uses. Boss provides estimates for individual RFID components as follows:

- Exit sensor: $4,000

- Portable scanner: $4,500

- Self-checkout unit: $20,000

- Bookdrop unit: $2,500

- Exit readers: $4,000[19]

The most expensive aspects of any RFID system are the cost of the tag and the cost of placing the tag on each item. Tags range from 20 cents to 75 cents for books. The costs go up when tags are placed on other media such as CDs, DVDs, and tapes ($1 to $1.50 each). Customized tags (library logo) increase the costs of each tag further.

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[17] Smart, LJ (2005, January 5.). Considering RFID: Benefits, limitations and best practices . *C&RL News* 66(1)

[18] Hesseldahl, A (2004, July 29). A hacker's guide to RFID. *Forbes.com.* Retrieved August 6, 2004, from www.forbes.com/home/commerce/2004/07/29/cx_ah_0729rfid.html.

[19] Ibid., 5.

Once a library purchases tags, it is committed to the tags and the vendor. As Molnar (2004) states, "Once a library selects an RFID system, it is unlikely that anything short of catastrophe could motivate a library to spend the money and labor required to physically upgrade the tags."

At 75 cents per tag, a 100,000-item library would spend $75,000 on tags alone. Boss estimates a laborer can install three tags per minute (new installation). The cost of programming the new tags, removing the old tags, and placing the new tags in each item makes converting or upgrading the library's RFID system highly unlikely.

Role of Librarians

RFID technology introduces an ethical dilemma for librarians. The technology allows for greatly improved services for patrons, especially in the area of self-checkout. It also allows for more efficient use of professional staff and may reduce RSIs for library workers. And yet, the technology introduces the threat of hotlisting and tracking library patrons. Librarians have taken extra steps to ensure that laws such as the USA PATRIOT Act cannot be used by government entities to invade the privacy of their patrons, but many of those same libraries are placing trackable chips on their patrons' books. Although libraries have traditionally acted to protect and defend the privacy of their patrons, some are implementing a technology before proper safeguards have been developed.

Library use of RFID technology serves to legitimize the technology in the eyes of the community. Therefore, it is incumbent on the library community to ensure that the technology is developed in concert with established privacy principles and that any library use of RFID follows best-practices guidelines consistent with library values.

Privacy Protections for RFID by Industry and the Government

The Privacy Act of 1974 articulates certain principles for protecting privacy. Since its passage, these principles have been applied to specific technologies and practices. Paula Bruening, staff

counsel for the Center for Democracy & Technology, describes the underlying principles as follows:

- Notice. Information collection and use should be open and transparent.

- Purpose specification. Personal data should be relevant to the purposes for which it is collected.

- Use limitation. Data should be used only for the purpose for which it was collected.

- Accuracy. Personal data should be accurate, complete, and timely.

- Security. Personal data should be protected by reasonable security safeguards against risk of loss, unauthorized access, destruction, use, modification, or disclosure.

- Access. Individuals should have a right to view all information that is collected about them to correct data that is not timely, accurate, relevant, or complete.

- Accountability. Record keepers should be accountable for complying with fair information practices. [20]

Organizations such as the Center for Democracy & Technology and the Electronic Frontier Foundation[21] have joined with Consumers Against Supermarket Privacy Invasion and Numbering (CASPIAN)[22] to issue a similar position statement composed of three recommendations:

- A formal technology assessment should be undertaken before any tags are affixed to individual consumer products.

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[20] Bruening, P (2004). Testimony presented at House Subcommittee on Commerce, Trade and Consumer Protection on July 14, 2004. Washington, DC. Retrieved August 4, 2004, from www.cdt.org/testimony/20040714bruening.pdf.

[21] Tien, L (2004, January 10). RFID and libraries: EFF talking points for ALA IFC. Summary of presentation to the ALA Intellectual Freedom Committee of the American Library Association at ALA Mid-Winter, San Diego, California. Retrieved from www.privacyrights.org/ar/RFID-ALA.htm.

- RFID implementation should be guided by Principles of Fair Information Practice (such as The Eight-Part Privacy Guidelines of the Organisation for Economic Co-operation and Development (OECD).

- RFID should be prohibited for certain uses.

Librarians are well aware that they are the stewards of private information about their patrons. The ALA Code of Ethics states, "We protect each library user's right to privacy and confidentiality with respect to information sought or received and resources consulted, borrowed, acquired, or transmitted." [23] Lee Tien, staff attorney for the Electronic Frontier Foundation, states, "Libraries have long been very protective of library patron privacy given that surveillance of reading and borrowing records chills the exercise of First Amendment rights." [24]

> There are currently no U.S. laws or regulations on the books that pertain to privacy or consumer rights vis-à-vis RFID despite Debra Bowen's (Senator of the 28th District of California) attempts to change that. State Senator Bowen propoted Senate Bill No. 1834, a bill that would have added an RFID chapter to Division 8 of the Business and Professions Code. The bill would have prohibited libraries from "using RFID tags attached to circulating materials to collect information that could be used to identify a borrower unless specified conditions are satisfied. [25]

Although SB1834 did not pass the state assembly vote, it is instructive to review the guidelines Senator Bowen proposed for library use of RFID:

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[22] Consumers Against Supermarket Privacy Invasion and Numbering (CASPIAN). (2003). *Position statement on the use of RFID on consumer products.* Available from www.privacyrights.org/ar/RFIDposition.htm.

[23] American Library Association (2004). Code of Ethics of American Library Association. Retrieved August 5, 2004, from www.ala.org/ala/oif/statementspols/codeofethics/codeethics.htm.

[24] Ibid., 21.

[25] S.B. 1834. Radio frequency identification systems. California Senate, 2003-2004 Regular Session. Retrieved August 4, 2004 from http://www.leginfo.ca.gov/cgi-bin/postquery?bill_number=sb_1834&sess=CUR&house=B&author=bowen

A library may not use an electronic product code system that uses radio frequency identification (RFID) tags attached to circulating materials to collect, store, use, or share information that could be used to identify a borrower unless all of the following conditions are met:

(a) The information is collected only to the extent permitted by law.

(b) The information has been voluntarily provided by the borrower for the purpose of registering to use the library's collections and services or for the purpose of borrowing an item from the library, including an item containing an RFID tag.

(c) The information is not collected at any time before the borrower actually attempts to borrow the item or at any time after the customer completes the transaction to borrow the item containing the RFID tag.

(d) The information is collected with regards only to a borrower who actually attempts to borrow the item and is in regard only to that item."[26]

Given their commitment to a "library user's right to privacy and confidentiality with respect to information sought or received," librarians and library organizations should be working closely with Senator Bowen, the Center for Democracy & Technology, the Electronic Frontier Foundation, and any other advocates of safe and responsible use of RFID technology. Instead, many libraries are quietly implementing RFID systems because of the convenience while ignoring the possible problems the technology introduces.

Best-Practices Guidelines for Library Use of RFID

Because libraries are implementing RFID systems, it is important to develop best-practices guidelines. Given the immature state of RFID implementations in libraries, guidelines are very

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[26] Ibid., 25

much in flux because libraries are just now beginning to understand the implementation issues, shortfalls with the technology, and the greater privacy concerns.

For the library considering RFID, Molnar suggests that libraries ask potential vendors whether they plan to develop a system that allows for rewriting tags on every checkout and then restoring the ID at check-in. This process eliminates the problems associated with storing static data on the tags and eliminates the problems of tracking and hotlisting. The ability to write new data to the tags during circulation requires the library to use read/write tags capable of supporting all the check-ins and checkouts the item will require over its lifetime. The library will need to determine how many writes will be required and then identify a vendor that will support such a protocol.

When a library is preparing an RFP for RFID technology, Ann Cavoukian recommends including:

- The institution's obligations with respect to the notice, access, use, disclosure, retention, security ,and disposal of records

- A requirement that the institution maintain control of, and responsibility for, the RFID system at all times

- The designation of a senior staff member to be responsible for the institution's privacy obligation and its policy[27]

Incorporating and expanding on the efforts of the Berkeley Public Library, San Francisco Public Library, Cavoukian, and the Privacy Rights Clearinghouse[28], the author proposes the following best-practices guidelines for library RFID use:

- The Library should be open about its use of RFID technology, including providing publicly available documents stating the rationale for using RFID, the

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[27] Cavoukian, A, PhD (2004, June). Guidelines for using RFID tags in Ontario public libraries. Toronto, Ontario: Information and Privacy Commissioner.

[28] Givens, B (2004, January 10). RFID implementation in libraries: Some recommendations for "Best Practices." Summary of presentation to the ALA Intellectual Freedom Committee of the American Library Association at ALA Mid-Winter, San Diego, California. Retrieved from www.privacyrights.org/ar/RFID-ALA.htm.

objective of its use and any associated policies and procedures, and the name of the person to contact with questions.

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

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

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

- Information describing the tagged item should be encrypted on the tag even if the data is limited to a bar code number.

- No static information should be contained on the tag (e.g., bar code, manufacturer number) that can be read by unauthorized readers.

- All communications between tag and reader should be encrypted via a unique encryption key.

- All RFID readers in the library should be clearly marked.

- ISO 18000 mode-2 tags rather than ISO 15693 should be used.

Educating the Public

Karen Schneider suggests that the debate concerning RFID "takes us farther into the question of what our role in society is as libraries." She further states:

We have a chance here—not simply on behalf of library users and librarians, but also for society at large—to present an ethical approach to RFID and similar technologies, to actually present a framework for how to do this and preserve privacy in an increasingly non-private world. And conversely, if we don't develop best practices, I think we are acceding to an increasingly commercialized, non-private world and we're losing an opportunity to do something that we've

always done very well, which is to find intellectual freedom and privacy issues in a particular

technology and speak to them very clearly in a way that the public can understand.[29]

It is incumbent on librarians to educate the public about the possible abuses associated with

RFID for two reasons: because libraries have an interest in using the technology and because

the threat to privacy posed by "ubiquitous computing"—of which RFID is a part—is significant.

Emile Aarts, Rick Harwig, and Martin Schuurmans argue, "the ubiquitous computing

generation will further expand on distribution until a huge collective network of intelligently

cooperating nodes is formed." They suggest that the capacity of the Internet and the ability to

connect wirelessly to the network has the effect of "moving technology into the background."[30]

Librarians can help ensure that technologies designed to be hidden in the background

remain public, at least until the public understands how the technology works and has had a say

about how it should be used.

One, if not *the* single most important, reason for the existence of public libraries is to

promote an informed citizenry. What better time than now to actively promote education of our

citizens about technologies that promise to alter our lives so dramatically.

Conclusions

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. To remediate those costs, efforts must be undertaken to guide its development and

implementation.

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[29] Flagg, G (2003, December). Should libraries play tag with RFID? *American Libraries, 34(11), 69-71* Chicago: American Libraries.

[30] Aarts, E, Harwig, R, Schuurmans, M (2002). Ambient Intelligence. In P.J. Denning (Ed.), *The invisible future*, pp.235-250). New York: McGraw Hill.

Libraries should not yet implement RFID systems. Instead, libraries should be among the entities putting pressure on government and industry organizations to develop standards, public policy, and best-practices guidelines for their use.

Libraries that choose to implement RFID technologies before policy safeguards are put in place should take extra precautions to follow evolving best-practices guidelines.

Libraries should continue to protect patrons' 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. They should refuse to implement potentially unsafe RFID solutions simply because they are convenient.

Finally, libraries must be outspoken in their public education efforts related to RFID not only because they 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.

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www.nbr.co.nz/home/column_article.asp?id=9531&cid=5&cname=Asia+%26+Pacific.

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