

TECHNOLOGY, STANDARDS, AND IMPLEMENTATION

RFID is gaining popularity across the broadest reaches of today's industries. As one market pulls from the technology available, another pushes the technology a step further into the future. Meanwhile, standards organizations are tasked with harnessing the rapid progress of technology suppliers while protecting the compatibility of early adopters. At Tech Logic, we aim to educate the customer, to research the ever-evolving technology, to clarify intimidating standards, and to embrace an interoperable solution. The purpose of this paper is to shed light upon the basics of RFID, and the subtleties that differentiate our RFID offering from those of our competitors.

RFID Overview

Radio Frequency Identification (RFID) first appeared in the early 1980's when it was used for item tracking and access control applications. These wireless automatic identification data capture systems enable non-contact reading or writing of data and content in environments where barcode labels requirements are too limiting or where the barcodes would not survive. RFID has established itself in a wide range of markets and continues to do so as the technology becomes more affordable.

An RFID "system" for the library market is comprised of three components:

1. An RFID tag consisting of a chip and antenna
2. An RFID reader connected to the library information system to read/write information from and to the RFID tag.
3. An RFID antenna connected to the reader that emits power and data from and to the RFID tag.

The combination of the RFID reader and antenna is an RFID station. The communication between the RFID tag and the RFID stations is wireless, so it's possible to read or write data in the RFID tag from a distance and to perform multiple reads or writes simultaneously, such as in a stack of books at checkout.

TECHNOLOGY



Tags

Tech Logic uses 13.56 MHz, ISO standard tags and writes the library's standard barcode number on the tag's chip.

Your library can purchase ISO standard tags from Tech Logic, our competitors, or other available sources at any time in the future. Such tags are interchangeable and may co-exist within the same system of RFID readers and antennas with nearly equal performance. Tech Logic guarantees all tags for the life of the items they are adhered to.

Readers and Antennas

Tech Logic uses standard, off-the-shelf OEM products. It does NOT modify the reader firmware in any manner. Some competitive RFID vendors incorporate proprietary code into the reader, and use encryption keys to make their RFID system proprietary. Although these systems may use ISO 15693 tags, the manner in which they implement the system limits the selection of the tag and reader to a single source.

Tag Read Rates

Some vendors claim that their tag reads at a rate of 70 books per second, while others are reading at only 40 or 50 books per second. Tech Logic finds no appreciable difference between reading a tag every 15 milliseconds versus 25 milliseconds in an actual library checkout, circulation desk, or security gate application. Such claims, although technically accurate, do not have a measurable impact on the operational performance of the application. The limiting speed at the application level are not reader/tag rates but rather, software, database response times and patron and staff activity rates.

Security

ISO 15693 and ISO 18000 incorporate a feature called the Application Family Identifier (AFI). The AFI provides a means to group tags into categories by assigning similar hexadecimal numbers into a defined memory block. This provides an efficient method for a reader to communicate a single command to a large group of tags.

Although not specified in the ISO standards, one silicon manufacturer (Philips Semiconductor) incorporated an Electronic Article Surveillance (EAS) function in their ISO compliant chip. Other silicon producers do not incorporate a separate EAS feature. Tech Logic has consulted with several RFID hardware manufacturers to determine the best way to implement a reliable security detection method that will function with any ISO chip. The recommendation is to use the Application Family Identifier (AFI) byte for security. The AFI exists on every ISO chip and may be used at the discretion of the user. Tech Logic hardware, software, security gates, and tags all use the AFI byte as the security byte. This makes security “truly” non-proprietary and uniform between 13.56 tags, ISO 15693, and ISO 18000.

When the AFI byte is used in this manner, the security gate controller is configured to read each tag to determine whether the AFI byte matches the hexadecimal value Tech Logic assigns as the theft indicator.

The gates will activate audio and/or visual alarms, can activate other devices (such as security cameras), and can capture the barcode number of the item that has not been properly checked out. The captured barcode number can then be recorded using Tech Logic CircIT Software at any PC within the library’s network system via an addressed TCP/IP connection. The library then has localized audio and visual alarms and remote collection of these items.

The Most Suitable Frequency

Several large retailers, the Department of Defense, and the Food and Drug Administration have mandated their suppliers to begin marking pallets and case goods with an EPC compliant, RFID tag. With such a significant endorsement by this group of users, a question is raised: What is the most suitable standard for libraries to use for an RFID system -- this EPC tag or 13.56MHz? EPC tags in the United States operate at 915MHz. This ultra-high frequency operates at the near microwave range. Read distances for UHF tags are upwards of 10 to 15 feet and with such a great bandwidth, many hundreds of tags can be read every second.

For all its great features, UHF radio waves are easily absorbed by human fluids and accordingly would not provide reliable detection at the security gates. Furthermore, the read range is so great it would pose problems at checkout stations. Patrons could not be assured that they are checking out their items as opposed to another patron's items perhaps five feet away at another checkout station. For these reasons, the library market is deploying 13.56MHz in their library applications.

STANDARDS



ISO Standards in the Library

Understanding ISO standards can be rather confusing. Under most circumstances, it's not necessary for a library to be conversant in such highly technical documents. Yet it is vital from a systems perspective. As such, it's important to provide insight into the RFID systems libraries may be considering, while clarifying potentially misleading information on the market about the ISO 18000 standard.

The ISO 15693 standard emerged in 1999 after more than a year in development within the ISO committees. It defines the technical aspects, along with the minimum functional requirements for the exchange of data between a reader and a tag. It's a primary building block for passive, high frequency RFID standards and is incorporated as a referenced component in the ISO 18000-3 standard.

ISO 18000 is intended to encompass a wide range of radio frequency identification devices. The scope of this standard is very broad as it categorizes RFID into its many forms. It gathers other RFID frequency ranges not covered under ISO 15693 under one umbrella. One such category, ISO 18000-3, covers passive tags operating at 13.56MHz, the frequency used in library applications. In addition, ISO 18000-3 defines two Modes that a tag MAY operate: a Mode A and a Mode B. Mode A specifies the use of the ISO 15693 protocols. Therefore, an ISO 15693 compliant tag is also compliant to the ISO 18000-3 Mode-A specification.

Mode B is a second tag protocol, developed by an Australian based company, which was added to the ISO 18000-3 standard as a Mode B. The Mode B protocol provides a very unique performance characteristic in being able to read uniformly stacked tags such as might be found in casino gaming chips.

There are several important points to consider in this regard:

- *The Mode A and Mode B protocols are entirely different.*
- *Mode A is based on a free and open standard with many successful installations across many industries, including libraries.*
- *At this time, Mode B requires licensed use.*
- *The ISO 18000-3 standard does not require a reader to simultaneously support Mode A and Mode B*
- *An ISO 18000-3 Mode B tag DOES NOT comply with ISO 15693. As such, an ISO 15693 reader WILL NOT read an ISO18000-3 Mode B tag!*
- *Most RFID hardware and chip manufactures are unlikely to pay a license to this Australian company to use the Mode-B protocol.*
- *Adopting an ISO 18000-3 Mode B product significantly limits reader and tag sources.*

ISO 18000-3 Mode-A, and any future ISO standards based on the ISO 15693 protocols, provides an assurance of unimpeded operation and access to the greatest number of sources for tag and reader equipment to a library whose system deployed with such standards.

The distinctions noted above between the mode A and mode B of the ISO 18000 standard are important to libraries. One RFID supplier is proclaiming they are ISO 18000 compliant, which is true, but they are offering the Mode-B protocol, thereby limiting access to the large number of sources that provide RFID readers and tags... in fact, limiting the number of potential competitors.

Tech Logic and ISO Standards

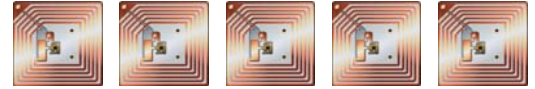
Tech Logic RFID implementations are based on the ISO 15693 standard, the content of which carries forward to ISO 18000. This standard defines the radio frequency band, command instructions, and communication protocol of the “air interface” that occurs between tag and reader. These standards DO NOT define the data content, format or location of the information that is placed into an RFID tag.

It's in these areas that various vendors of RFID products can make their products proprietary in nature and therefore either interoperable with other RFID products, or not.

Until the standard goes beyond the core technology to include data content, formatting, etc. Tech Logic has taken the approach of fully disclosing the data mapping it uses to store information on the chip. This information is provided to the library when the initial contract is executed. A data map is the key to future standards. By mandating the use of ISO compliant tags with a defined data content and memory block location to store such information on the RFID tags, a library will be immune from sole source RFID vendors and proprietary offerings. A library may then go to any RFID vendor, specify the data map, and continue in an unimpeded fashion with their RFID operations.

As the new ISO 28560 standards have come to fruition, Tech Logic has maintained its standards of interoperability to utilize these standards in whatever implementations our client libraries have chosen.

IMPLEMENTATION



Print Materials

The tag/label may be installed anywhere within print materials because RFID is easily read through the items at both security gates and checkout/in readers and antennas. However, for inventory and shelf reading, we recommend that libraries should place tag/labels on the inside of the back cover, close to the spine, and staggered in an area starting from the bottom of the book and extending upwards to roughly 3" or 4" from the base.

The staff member can then rely on a relative tag location when scanning bookshelves. He/she does not have to scan high and middle areas of the shelves when searching and/or performing inventory.

CD and DVD Cases

Tech Logic recommends the use of the CD/DVD tag/label directly placed on the item when there is only one item within the CD/DVD case. This offers the best protection because the tag/label is directly adhered to the CD/DVD. Several new features are now being deployed (since January 2004) in conjunction with the CD/DVD tag/label. Since the CD/DVD tag has a smaller antenna than the square book tag and the CD/DVD manufacturers provide CD/DVDs with the aluminum extended to the center CD/DVD hole, Tech Logic now provides a booster antenna that slides into the CD/DVD case.

The booster antenna provides the CD/DVD with the same read distance as the square book tag/label. This is critical when using Tech Logic's large area antennas that can check out four stacks of four items per stack. The booster antenna also assures that items passing through security gates won't have center area dead spots. Multiple item CD/DVDs (books on CDs, multiple disc movies) should have the tag/label placed on the inside cover similar to print materials. Tech Logic has tried placing tags on each item and found that this was cost prohibitive and non-readable due to aluminum mass.

STEPS TO PROGRAM AN RFID TAG

Tech Logic recommends that existing items should be fitted with tags and covering labels that do not have barcodes pre-printed on the label. This is because the existing library item already has a barcode and there is no need to have two barcodes on a library item. New items should use tags with covering labels that have pre-printed barcodes on the labels. Tag/labels should be installed into the item as previously discussed above.

In either case, a staff member merely scans the item's barcode using an industry standard barcode scanner while the newly tagged item is on the RFID antenna. Tech Logic's CircIT software will automatically write the barcode on the tag's chip. The user can then verify that the barcode number was programmed, and the process of programming a tag is finished.

RFID ANTENNA/READER DESIGN CRITERIA

Tech Logic offers several antenna sizes. These antennas can read several items at a time. We also employ a ferrite redirector. The ferrite material provides a unique feature and dimension in RFID technology because it focuses radio waves to read only books that are on top of the antenna area.

The focused read area eliminates the reading of items that could be under the desk or alongside the antenna areas. Additionally, Tech Logic manufactures attractive, durable covers for its antennas that provide a durable, scratch resistant surface. (The covers are available at an additional cost and can be made to match the library's checkout desk covers.)

Several Tech Logic RFID system installations have the antennas mounted beneath the counter. The library will see the best results and reduce patron confusion by using the single or twin counter-top covered antennas with tapered edges, placed on top of the desk. The obvious protrusion of the tapered edge antenna on top of the desk gives the patron a defined area on which to place books at checkout time. (It seems that patrons set items either on or off the antenna. When we put antennas under the desk, patrons would set books half on the RFID read area and half off, causing problems.)

INTEGRATED LIBRARY SYSTEMS

All of Tech Logic Checkin, Checkout, Sorting Systems, and Distribution Systems use SIP 2.0 with to communicate with most integrated library systems.

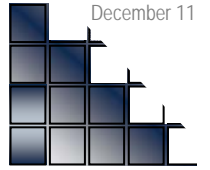
SUMMARY



The adoption by libraries of RFID-based technologies and associated applications has provided significant benefits in terms of patron experience, improved materials handling, and staff work environments. Early adoption within the library has necessarily been accompanied by a plethora of options, competing approaches, and technologies.

This paper provided a summary view of the key attributes in considering RFID technology: which standards are important and some basic background on the implementation of the technology. While the decision to move forward with RFID within a library or library system is important, adopting interoperable and nonproprietary implementation may be equally important from a sourcing, pricing, migration, and service standpoint.

Tech Logic and its partner companies are committed to delivering high quality solutions, products, and services to libraries in a way that maximizes your investment, while preserving your ability to take advantage of market improvements available due to interoperable and non-proprietary implementations.



RFID in American Libraries
