



# Create a more human library

## RFID 501: RFID Standards for Libraries

This is an exciting time in the evolution of RFID (radio frequency identification) technology for libraries. National and international committees will soon finalize a number of important standards that have been under development for several years. These new standards will improve the interoperability and flexibility of library RFID systems and make the technology even more valuable.

- **Interoperability.** Shared standards will allow one manufacturer's tags to be recognized and read by equipment from another manufacturer. This capability is increasingly important as library networks become more integrated—as more books and CDs from one library system are loaned to other systems. Interoperability also increases the potential for tagging by publishers and distributors.
- **Flexibility.** The new standards will also give libraries greater flexibility in designing their systems and purchasing their equipment and tags. With standards, they can make purchasing decisions based on features and performance without worrying about compatibility with equipment that has already been installed in the library.

Standards also give libraries a measure of confidence in their investments. Although standards certainly can change, libraries can be assured that such changes will be accepted throughout the industry and that a system purchased today won't be quickly outdated.

### Hardware versus Application Standards

Two kinds of standards affect RFID. Hardware or technology standards address equipment issues; software or application standards address the arrangement and handling of the data that is handled by the equipment.

Several years ago, the International Standards Organization (ISO) began to establish RFID technology standards that affect RFID applications in different settings—such as security access, payment systems, retail stores and libraries. These technology standards address the communication

between the tags and the readers; they do not address RFID tag or equipment quality or reliability.

One of these ISO RFID technology standards—known as ISO 15693—addressed contactless integrated circuit devices, which are sometimes called proximity cards. These are used for security access or payment systems. These applications are typically designed to identify people, but some manufacturers saw that the same standards could be applied to the identification of items. Some early item identification applications were based on ISO 15693.

Eventually, ISO developed a new series of standards—the ISO 18000 family—that addresses how tags and readers communicate in a number of item identification applications. One of these, ISO 18000 Part 3, identifies 13.56 MHz as the frequency for tag-reader communication in these applications. ISO 18000 Part 3 Mode 1 is the type of tag commonly used in many of these applications, including libraries.

These hardware standards are obviously necessary, but they are not sufficient to allow interoperability among libraries. Setting the communications frequency ensures that the reader and tag are on the same wavelength. This is similar to presetting a car radio to a favorite station. It does not address the “language” of what's being broadcast, though. For RFID systems to work together, the language also needs to be standardized.

### Storing Data on an RFID Tag

To understand the value of a common language, consider how data is stored on an RFID tag. In the United States, each library item is usually identified with a unique 14-digit number. Before that number can be encoded onto the RFID tag, it must be converted into the zeros and ones that make up the language of computers and RFID tags. It is then programmed onto the tag.

The data can be converted to ones and zeroes on the tag in several ways. (Nothing in the technology standard—ISO 18000 Part 3 Mode 1—prohibits the use of any method.) Each method encodes the number differently. Additionally, there are many locations on the tag where the data may be placed.

Consequently, only someone who knows and employs the approach used in the original coding and location can decode the tag and generate the correct identification number.

Without a standardized approach to coding, a library often cannot decode an RFID tag and correctly identify an item it receives from another library. Obviously, this impacts interoperability and customer satisfaction. Additionally, without a standardized approach, a library might be forced to purchase replacement equipment based mainly on the encoding method originally used on the tags, or face a significant expense to reprogram the tags in the collection. These are among the reasons why many libraries have been closely monitoring the evolution of application standards.

## Applications Standards: A Status Report

The library RFID industry started with a diverse set of models for handling data, each determined by the individual manufacturers.

Eventually, four countries adopted national models. The Dutch standard was developed in 2003 by a consortium organized by a large book producer who was selling into the library industry. The Danish standard was next, in 2005. The following year, a Finnish standard was adapted from the Danish model, and an independent standard was developed by the French.

In the United States, the National Information Standards Organization—also called NISO—formed a working group in 2005 to study RFID for the nation’s libraries. The group includes representatives from manufacturers, book jobbers, libraries and industry groups. Although the focus is on U.S. libraries, several members bring an international perspective to the discussions. In 2008, the group approved a recommended best practice for U.S. libraries, which is now available on the NISO Web site at <http://www.niso.org/publications/rp/RP-6-2008.pdf>.

In addition, the ISO has sponsored an international working group to develop RFID application standards for libraries.

## Fixed and Object-Based Encoding

Each of the four European models uses a “fixed encoding” approach, in which the placement of data on the tag is prescribed and a definite number of bytes is allocated for each piece of data. When the NISO working group started its work in 2005, it analyzed the Dutch and Danish models, which were the only national standards existing at the time. The NISO group decided that those fixed-encoding models lacked the flexibility that would be desired in a U.S. standard, so it started work on a new “object-based” approach.

A similar approach to application standards has been adopted by a number of other RFID working groups, including the ISO’s international working group for library RFID and groups working on RFID standardization in the United Kingdom and Australia.

This object-based approach was based on ISO 15962, an existing standard that specifies how data objects—which are essentially pieces of data—should be encoded on RFID tags.

With object-based encoding, the tag is programmed with data objects, which could include the item identification, the media format, the home library, the interlibrary loan borrowing institution, a transaction number or something else. The encoding of each data object tells the reader how that object is compacted on the tag and the size of the data. And then it gives the actual data.

Object-based encoding, as defined by the ISO 15962 standard, has proven its flexibility and efficiency through years of use in several industries.

- **Flexibility.** With object-based encoding, ISO can add new data elements (for example, a book’s weight) when the industry deems it necessary. This approach allows each nation—and each library—to decide the size of the tag and which of the ISO-approved data elements it wants to use for its unique requirements.
- **Efficiency.** Object-based encoding treats numeric data in a manner that’s efficient for numeric data. If the information is in an alphanumeric format, it is encoded in a manner efficient for alphanumeric data. This efficiency saves tag space, which is important because it impacts tag size and the time needed to read the data.

The left side shows how an item would appear on an RFID tag encoded using the Danish model. On the right is the same information, encoded using the object-based approach.

Note the unused blocks on the right. Some are empty because object-based encoding does a better job of condensing the identifying numbers. The item ID—seen here in yellow—requires twice as many blocks using the Danish model. The library ID—at the bottom of the tag—is also slightly longer.

Other blocks on the right are empty because of the flexibility of object-based encoding. The fixed model on the left demands that certain information always be specified. In contrast, the object-based approach allows the system to set defaults. Assume, for example, that this example is a book and that the object-based system has defined “book” as the default case. Unless the tag says otherwise, the reader system can assume the item is a book. Because this information doesn’t need to be included on the tag, the tag has more open space.

Because the data set is smaller with object-based encoding, the system can use smaller tags. And because the system only needs to read the portion of the tag containing data, it spends less time reading the tags, which means better performance in the library.

The efficiency of object-based encoding varies somewhat, depending on the data set.

This visual shows how object-based encoding compares with the Danish model in six instances. In the fourth data set, the object-based encoding requires slightly more space than the fixed encoding. This will happen occasionally, but it is the exception. In most cases, object-based encoding is more efficient—sometimes dramatically so. (For details on the data used in the six examples above, see Appendix 1.)

## The Application Family Identifier

Another feature of object-based encoding is that the ISO standard on which it is based—ISO 15962—contains an Application Family Identifier, or AFI, code.

The AFI code serves several purposes. It was originally developed to distinguish applications, so that a tag will respond to a reader only if the AFI codes match. This eliminates interference between applications. For example, it ensures that an airport baggage-handling RFID system reads and responds only to baggage-handling RFID tags and not to the tag in a library book packed within a suitcase.

In addition, several RFID vendors use the AFI as a security mechanism. There are two AFI codes, one for items that are checked in and another for items that are checked out. When a patron takes an item through the library’s security gates, the system asks the tag to respond if it has not been checked out. If it responds, the alarm will sound.

This example below illustrates the efficiency of object-based encoding.

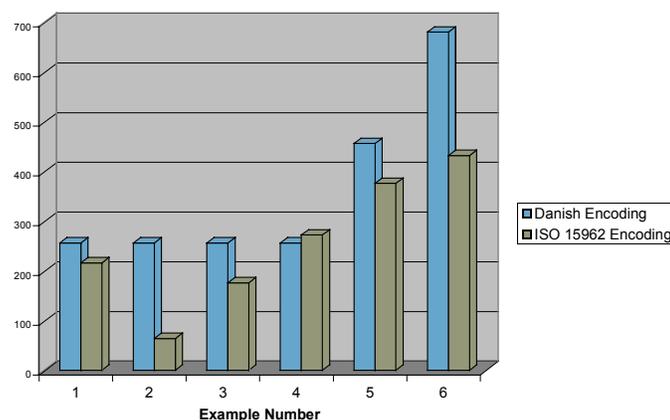
Fixed (Danish) Encoding

1	1	0	1	0	1	3	3
3	2	3	0	3	9	3	2
3	0	3	1	3	2	3	1
3	4	3	4	3	3	3	7
3	3	0	0	0	0	F	F
F	F	4	4	4	B	3	7
3	1	3	0	3	1	3	0
3	0	0	0	0	0	0	0

Object-based Encoding (ISO 15962)

1	1	0	6	1	D	3	0
0	0	F	B	E	6	F	5
0	2	0	1	D	0	6	5
0	1	0	1	4	3	0	7
1	0	B	B	7	7	C	7
0	C	7	0	C	2		

Tag Memory Requirement Comparison



## ISO Standards: a Status Report

As noted earlier, the ISO has formed an international working group to develop applications standards that will allow global interoperability. At this time, it appears that this international effort will support one global standard for defining RFID tag data elements.

The ISO effort is expected to support two encoding schemes. One will be fixed; it will probably be close to the Danish model. The other one will be object-based and consistent with the ISO 15962 standard that NISO is recommending for use in the U.S.

Recently, drafts of the three ISO standards (one for data, two for encoding) were completed and circulated among the participating countries and bodies. Final standards should be published by the end of 2008. At this time, only the primary item identifier is mandatory. If additional memory elements are specified, then the OID index (which is a register of all the data elements that are stored on the tag) will also be mandated.

Even though final publication is some months away, many library systems are moving forward with plans to implement RFID systems. Any variations from the draft standards are expected to be minor and established vendors will have little or no problem adapting the planned systems to accommodate any changes.

## What Should You Expect From Your RFID Vendor?

What should libraries expect from an RFID vendor? First, your vendor should monitor and, ideally, participate in the standard-setting activities previously described. This indicates a commitment to the industry and the library market.

Second, your vendor's product should reflect the latest developments in standards.

Third, your vendor should be willing to support your migration to utilize changes in those standards when they are available. That commitment to support a migration should be explicit. To ensure that you can migrate, it is critical that the data on your tags is not locked. Data on an unlocked tag can often be reprogrammed to conform to a revised standard. Locked data is permanent and cannot be altered.

For links to learn more about the evolution of tag standards in several markets around the world, see Appendix 2

## Appendix 1.

### Data Set: Danish versus ISO 15962 encoding models

This list contains the data that was used in the six-example comparison of the Danish encoding model to ISO 15962 encoding.

#### Example 1: Standard Danish Data

Item ID: 32092012144373

Type of Use: Circulating

Set Info: Part 9 in a set of 9 items

Owner Library: DK-710700

#### Example 2: Minimum NISO Data

Item ID: 32092012144373

#### Example 3: AlphaNum ID + Sets

Item ID: 9ZAR01D06S06TLF

Set Info: Part 15 of 15 items

#### Example 4: AlphaNum ID + Sets 2

Item ID: 9ZAR01D06S06TLF

Type of Use: Circulating

Set Info: Part 19 of 19 items

Owner Library: DK-710700

#### Example 5: ASCII ID, Long Owner Library

Item ID: A&1!b\*27@8C~3#9d

Type of Use: Circulating

Set Info: Part 19 of 19 items

Owner Library: ORGA-12345678901

#### Example 6: ASCII ID, Long Owner Library

Item ID: A&1!b\*27@8C~3#9d#4\*\$E5%f6^G

Type of Use: Circulating

Set Info: Part 19 of 19 items

Owner Library: ORGA-12345678901

Example	Danish Size	ISO 15962 Size (bits)
1	256	216
2	256	64
3	256	176
4	256	272
5	456	376
6	680	432

## Appendix 2.

### Additional Information on Tag Standards Evolution

The following Web links provide additional information about the evolution of tag standards in several markets around the world.

- NISO RFID Best Practices Model  
[www.niso.org](http://www.niso.org)
- ISO Working Group  
[www.bs.dk/standards/rfid](http://www.bs.dk/standards/rfid)
- Application Family Identifier (AFI) assignment for Library Industry  
[www.bs.dk/standards/RFID/AFI\\_Preliminary.pdf](http://www.bs.dk/standards/RFID/AFI_Preliminary.pdf)
- Dutch RFID Data Model  
[www.debibliotheken.nl/content.jsp?objectid=5179](http://www.debibliotheken.nl/content.jsp?objectid=5179)
- Danish RFID Data Model  
[www.bs.dk/standards/RFID/RFID\\_Data\\_Model\\_for\\_Libraries\\_April\\_2006.pdf](http://www.bs.dk/standards/RFID/RFID_Data_Model_for_Libraries_April_2006.pdf)
- Australian Best Practices Document  
[www.sybis.com.au/Sybis/4n597-599%20proposal%20document.pdf](http://www.sybis.com.au/Sybis/4n597-599%20proposal%20document.pdf)
- Finnish RFID Data Model  
[www.lib.helsinki.fi/katve/toiminta/docs/RFID-DataModel-FI-20051124.pdf](http://www.lib.helsinki.fi/katve/toiminta/docs/RFID-DataModel-FI-20051124.pdf)
- French RFID Data Model  
[www.addnb.fr/IMG/pdf/normefrancaiseRFID.pdf](http://www.addnb.fr/IMG/pdf/normefrancaiseRFID.pdf)
- International Airline Transportation Association (IATA) use of RFID  
[www.iata.org/pressroom/briefings/2005-11-18-01](http://www.iata.org/pressroom/briefings/2005-11-18-01)
- Food Animal ID use of RFID  
[www.idtechex.com/products/en/articles/00000379.asp](http://www.idtechex.com/products/en/articles/00000379.asp)
- Health Industry Barcode Consortium (HIBCC) use of RFID  
[www.hibcc.org/PUBS/WhitePapers/RFID%20Guideline.pdf](http://www.hibcc.org/PUBS/WhitePapers/RFID%20Guideline.pdf)



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