Data sets, profiles and standards: creating interoperability & adding value to RFID within Australian libraries

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Abstract
This paper provides an update on the status of the new ISO data model standard for libraries and explores some of the issues facing Australian libraries wishing to maximise the benefits offered by the new standard. The potential for data profiles to add value in the interoperability context is explored, as are the complexities involved with mixed data profiles at the point of circulation. Some suggested guidelines for the selection of data elements under the standard are also offered for consideration.

Introduction

Many libraries will by now be aware that the new ISO 28560 “RFID in Libraries” data model standard has been published in draft form and, by the date of the VALA2010 conference, may well be issued in final form. The broad purpose of the data model standard is to enable interoperability between High Frequency Radio Frequency Identification (RFID) systems used by libraries, despite the fact these systems may be sourced from different suppliers. The task of implementing the new standard requires thought and effort on the part of both the library and supplier communities if maximum benefit is to be realised.

This paper is broadly divided into two sections. The first section comprises a review of the new data model standard and some of the key factors involved with its implementation. The second section specifically targets interoperability issues and opportunities for Australian libraries. This section also deals with the topic of data profiles and proposes that the emerging standard might represent a catalyst for a new and expanded view of what RFID might be able to accomplish within libraries.

Standardising library data on RFID tags

ISO/IEC 28560 Snapshot

Structure of the new standard

ISO/IEC 28560 is structured in three parts. Part one essentially represents a list of the data elements that libraries may choose to place on their RFID tags and defines the structure and usage rules for each element. In the draft version of the standard, twenty-five data elements are described. Although not grouped this way in the standard, the elements could basically be classified into six types:

1. Elements that uniquely identify within a library the item to which the RFID tag is attached. These include the primary item identifier number (analogous to the barcode number) and several alternative identifiers including the Global Trade Item Number (GTIN-13) code.

2. Elements that describe the item to which the RFID tag is attached. These elements include the ONline Information eXchange (ONIX) media descriptor, MARC 21 material descriptor, and item title. Also included is an element to indicate that the item may be of a type other than traditional library material, for example library equipment such as laptops or overhead projectors etc. This element may even be used to identify the RFID tag as being associated with a person, and a range of borrower types is included for this purpose.

3. Elements that identify the owner of the item to which the RFID tag is attached. These include the ISIL code of the owner library, subsidiary of the owner library, as well as provision for non-ISIL ownership codes.

4. Elements that are used in the circulation of the item to which the RFID tag is attached. These elements are particularly focussed on inter library loans (ILL)

and provide for identification of the recipient as well as transaction management.

5. Elements that relate to the acquisition of the item to which the RFID tag is attached. This set of elements includes various supplier and acquisitions process related data elements.

6. Elements for local use. The standard includes three elements, which may be defined at a local level and are designed to facilitate functionality or applications outside of the standard within a specific community of users.

Part two of the standard describes a method for encoding the selected data elements in a flexible manner based on another ISO standard: ISO/IEC 15962 “RFID for item management – Data protocol”. In part two encodings, only the primary item identifier from the list of data elements in part one is mandatory. All other elements are optional and may be included at the discretion of the individual library. The standard also includes a content parameter which serves as a kind of index where additional elements have been placed on the tag. By means of this index, suppliers may create systems with improved efficiency in reading from and writing to the tag.

Part three provides an alternative encoding methodology. Unlike part two where there is a single mandatory element while all others are optional, in part three encodings elements are grouped into blocks. The basic block, which is mandatory on all tags, includes five elements from the list. Other blocks of elements include the library extension block, the ILL block and the acquisitions extension block. A different philosophical approach governs the rationale behind the approaches taken by part two and part three encodings.

Part two and three encodings are not designed to natively interoperate although a method of identifying from an individual tag which encoding is being used will be provided in the standard. This essentially means that a compliant RFID library system will use either part one and two or part one and three of the standard. The data elements described in part one will be common to both but the encoding and the approach to the two schemes will be different.

It has been assumed that, in the interests of interoperability, the decision regarding the usage of part two or three encoding will be made along national lines. In Australia, Standards Australia has endorsed the flexible encoding method provided by part two of the standard. This method is also favoured by other countries such as the UK and the USA. So, for Australian libraries, RFID suppliers should be implementing parts one and two of ISO/IEC 28560, therefore enabling country-wide interoperability.

Relationship to existing RFID standards

The new standard specifies ISO/IEC 18000-3 “RFID for item management – Parameters for air interface communications at 13.56 MHz” Mode 1 as the only supported air interface at this time (ISO, 2009). ISO/IEC 18000-3 essentially describes the manner in which compliant tags and RFID readers communicate with each other, and is the foundation on which the vast majority of High Frequency RFID systems currently installed in libraries are built. The encoding of library data

elements for storage on the RFID tag under part two of the standard is accomplished according to the rules set out in ISO/IEC 15962. This particular standard could be conceptualised as describing an encoding engine. The standard is powerful and efficient and can select from a range of encoding options based on the nature of the data that is presented for storage on the tag, in this way ensuring efficient use of precious tag memory space.

Implications for Australian libraries using parts one and two of the standard
One of the consequences for Australian libraries is that the use of the flexible part two encoding scheme means that individual libraries will have choice as to which data elements are encoded on their RFID tags. Most existing proprietary data models developed by suppliers (or indeed national initiatives such as the Danish Data Model) tend to mandate specific data elements and so most libraries have not previously been presented with options in this area. Issues arising from this aspect of the standard will be considered later in this paper.

Item security
ISO/IEC 28560 does not prescribe the type of item security system that will be used to secure library materials as part of an RFID implementation. However, for libraries that choose to use the RFID tag itself for both identification and security purposes, the standard will describe a methodology using an internationally registered code for circulating library material (NEN, 2007). This method essentially uses the "Application Family Identifier" (AFI) field in the system part of the RFID tag to determine whether an item may leave the library. This field can be changed at the point of issues or returns to reflect the appropriate state of the item. All library material leaving the library should contain the international code registered to designate circulating library material.

In the interests of maximising interoperability, it is envisaged that suppliers who are using RFID tag based security will implement the AFI security scheme. Libraries whose interoperability needs extend to item security may want to consider specifying this methodology. Regardless of the security method employed, all tags in material leaving the library should have the AFI value correctly set. This enables other non-library RFID readers (such as those reading RFID tagged travel baggage at airports) to determine that the tags belong to another application "family" and therefore may safely be ignored.

Migration to the new standard

The community of RFID equipped libraries contains many different data models. Among these are models that are proprietary and are either in the public domain or not, as well as models which have been developed by individual countries and are used within national borders and, in some cases, across national borders. ISO/IEC 28560 will be the first data model for libraries formally standardised either internationally or nationally. Most RFID suppliers operating in Australia have made a commitment to implement the new standard within a period following its release as a final document and so migration from the old to the new will be required.

Discussions with several suppliers about migration strategies have revealed that in many cases it may be feasible to actually accomplish the migration as part of

standard circulation activities. At the point of material returns, for example, the RFID system could read the data from each tag, reformat it into the new model and then write it back to the tag as a set of standardised data elements. This process could be expected to add a little extra time to the processing of returns but is significantly more efficient than handling all of the library's collections separately and so may be the method preferred by many libraries. The process may be more or less complex depending on the number and type of data elements selected by the individual library.

Leveraging ISO 28560 for interoperability & other benefits

This section discusses some practical steps libraries can take in an attempt to maximise interoperability and other benefits as the publication of a final version of ISO/IEC 28560 nears.

Selecting data elements to be placed on the RFID tag

Once suppliers have implemented the new data model standard into their RFID solutions, libraries will need to decide what information beyond the primary item identifier they might wish to store on their RFID tags. For individual libraries as well as cooperative groups, there are a number of considerations when making this choice and each of these will be considered in turn.

Local needs

ISO/IEC 28560 part two will mandate only one data element: the primary item identifier. In a retrospective conversion of library material to RFID, this will most commonly be the number currently encoded into the barcode on each item. To operate the library as before but with an RFID tagged collection, nothing else is required to be stored on the tag. The question to be answered in each individual case is whether adding extra information to the tag actually adds value to the RFID implementation. In the context of local needs, some libraries will answer this question in the negative, however there may be scenarios specific to an individual library service that argue for additional data elements to be stored.

One example may be where the library employs a materials handling and sorting system. Such systems tend to derive their sorting decisions from information received over a basic protocol such as SIP2 from the Library Management System (LMS). The effectiveness of this arrangement depends firstly on the appropriate information being contained in the bibliographic or item record relating to the material being sorted and secondly on the ability of the LMS and SIP2 protocol combination to transmit it. In some cases, a problem in either of these areas may limit the functionality of the sorting system. For example, there may exist items needing special handling due to their small or large size or fragile nature. The bibliographic record on the LMS may not indicate these conditions and so a "Type of Usage" value, supported under ISO/IEC 28560 may be encoded onto the tag for this purpose.

Another example relates to self-service circulation in situations where either the LMS or the connecting network is unavailable. In many libraries, the self-service units are able to function when disconnected from the LMS, by storing transactions locally and

then uploading them once the problem is rectified. However, in many cases, without the LMS the self-service units are unable to determine which items presented to them by users are actually permitted for loan. This situation may result in reference or other non-circulating material leaving the library. By encoding the previously mentioned “Type of Usage” parameter with the appropriate value onto the RFID tag, such an item may be detected by the self-service unit and the loan prohibited despite the unavailability of the LMS.

A final example concerns information relating to items with multiple parts, commonly known as sets. One advantage of the fact that RFID readers do not need line of sight to extract data from RFID tags is the ability to verify that all of the items within a set are present at the time of loans or returns. Unfortunately, some LMS implementations do not handle sets particularly well and, even where they do, implementing set control on a self-service unit via SIP2 may be very difficult. Because sets are supported under the new data model standard, tag-based set information may used by the self-service unit to detect incomplete sets before a loan or return is permitted. In this way, even if a set was originally added to the LMS with only a single barcode number, the self-service system is able to verify completeness before the number is sent to the LMS as part of the transaction. This function may also have the potential to save time at the point of staff returns, by eliminating the need to inspect each part.

In these examples, operational value is being added by the additional information encoded to the RFID tag, either because the information is not contained in the LMS or cannot always be retrieved from it. As a general principle, keeping tag data to a minimum and not replicating what exists on the LMS without operational value being added should guide decisions regarding data element selection.

Interoperability requirements

Apart from local needs, the selection of tag data elements may be driven by the requirement to interoperate with other library services. This may be the case because the library is part of a consortium or may have some other reciprocal stock arrangement with a neighbouring library etc. In these cases, it may not be necessary that both libraries choose identical sets of data elements, but it may be necessary that they agree on a minimum set of elements to be present on every RFID tag. Once again, adding operational benefit should be the test against which the adding of additional elements beyond the primary item identifier is measured.

One element for example that might be included in a minimum set of data elements within a consortium is a specific library identifier. ISO/IEC 28560 supports a range of institutional identifiers, the principal one of which is the ISIL code (International Standard Identifier for Libraries and Related Organisations). These codes are standardised by ISO 15511 and may be derived from the National Union Catalogue (NUC) codes used by many libraries for inter library loans (ISIL, 2009). The new data model standard also supports the identification of libraries to a level lower than the ISIL, such as branch locations etc.

Other interoperability issues

Handling of mixed data element combinations

An obvious consequence of the new data model standard providing libraries with a choice of data elements is that, even where a minimum interoperability data set is established, some libraries may choose additional elements to place on their RFID tags. This has implications for the way in which self-service systems handle these extra elements as library material moves between services.

Consider for example a consortium of libraries sharing a common database. Library service “A” within the consortium chooses to implement ISO/IEC 28560’s data element relating to sets whereas other members of the consortium do not. Imagine a situation where an item from library service A is shipped to fulfil a reservation at a branch library belonging to one of the other consortium members. Imagine also that this item is a set consisting of a book and a CD, each of which has an RFID tag with an identical accession number but also containing information indicating that the two tags form part of a set. Essentially the data element for sets might indicate that the book is one of two and the CD is two of two in the set.

When this set is at its home library, the self-service unit may verify that both parts are present before sending the single accession number to the LMS to enable a loan or return. What though when this item is presented to a self-service unit at a neighbouring library, where sets are not managed using the ISO standardised data element? What will actually happen when the self-service unit reads two different RFID tags having the same accession number? If the self-service unit is not configured to handle sets, it may determine that two separate items have been presented for loan. What will be the consequence of sending both numbers to the LMS as though they were individual items?

Clearly, where mixed sets of data elements exist, all of the self-service units in the consortium either need to be aware of what other elements may be used within the consortium, or need to have a strategy to cope with unexpected data elements on the tag. The most robust solution might be the latter case, where self-service units are instructed to respond to unexpected data elements in a specific fashion. One possibility might be for the supplier of the self-service equipment to provide three options that could be selected by a library for each data element that could be encountered, but which is not used in the local library branches:

Option 1: Ignore the unexpected element. In this case, the self-service unit would simply disregard a data element which was not part of its local data set.

Option 2: Use the data element. In this case, the self-service unit would attempt to process the element in a way commensurate with the element’s intended use.

Option 3: Direct the user to take the item to a staff member. In this case, the transaction is not permitted and the borrower must seek help from staff.

While there may be other options that could be built into the processing engine of the self-service unit, the point being made is this; not only must libraries decide which elements to use, they must also ensure that their RFID suppliers build some common sense processing rules into circulation based RFID equipment. To date, the focus has been on obtaining a commitment from library RFID suppliers to implement ISO/IEC 28560. As the final standard nears, libraries will need to begin thinking

about the specifics of such an implementation, and what will be required from their suppliers in order to gain operational advantage from their choice of data elements.

ISO/IEC 28560 and Ultra High Frequency (UHF) based library RFID

The new data model standard has been brought into being for the purpose of increasing interoperability between RFID-enabled libraries. For this reason, while the inclusion of library RFID systems based on UHF were vigorously debated, in the end the working group took the consensus decision to limit the scope of the standard to High Frequency (HF) systems only (WG11, 2008). As a consequence, to be compliant with the new standard, an RFID system must be based on ISO 18000-3 Mode 1, which is the HF air interface used by the vast majority of libraries around the world.

While taking this decision, the working group recognised that UHF based systems may become more popular in libraries over time. Accordingly, a decision was taken to maintain the working group even after the standard has been completed, and to keep a watching brief on the development of UHF technology in libraries. It is entirely possible that the standard could be expanded at some point in the future to embrace the community of UHF users, should this community become a significant component within the installed base of RFID library systems. It must be pointed out though that the most likely benefit from an extension of the standard (perhaps by means of a fourth part) would relate *only* to interoperability within the UHF installed base. There are other significant technology issues preventing interoperability *between* UHF and HF systems, even if systems shared a similar or even identical data model structure.

Part two encoding under ISO/IEC 28560

As stated previously, ISO/IEC 28560 is aimed at improved interoperability, but RFID tag encodings based on part two or part three of the standard are not natively interoperable. Given these two factors, it is desirable that a situation is not created in Australia where libraries are forced to cope with *both* encodings on circulating library material. It is difficult to imagine a situation where an Australian library could not achieve anything that was required from their RFID system, by using parts one and two of the standard. Unfortunately, it is not difficult to imagine a situation where a library might inadvertently install an RFID system based on part one and three of the standard, without realising it, simply because that was what the supplier provided.

Some vigilance is obviously required. No longer is it sufficient to include in a tender document a request that suppliers must implement the new standard within a specified timeframe. As explained in the previous sections, libraries must also specify that the system be based on parts one and two, and that the circulation components must be capable of dealing sensibly with the range of data element combinations that we expect to arise over time.

Profiles

Geographic and sector based profiles

Minimum interoperability specifications for data element selection within consortia have been discussed in previous sections. Such specifications might be considered to represent a data “profile” which is applicable within a specific context. A broader

context also exists for minimum interoperability specifications – that of geographic and/or sector based profiles. At the time this paper is being prepared, several working groups are focussing on exactly these issues, both within library consortia in Victoria and New South Wales as well as within Australian states such as Western Australia.

It might also be worth exploring the potential to add operational value in establishing a national profile for RFID equipped libraries. Such a profile would not mandate what elements that a library might choose to add for local or regional needs but rather would recommend a minimum set of elements to be contained on all tags. The very fact that several working groups are active in this area within specific sub-national contexts suggests that a broader approach merits consideration also.

It is a fact that, to date, most implementations of RFID have been in public libraries. To some extent this has been a consequence of public libraries having relatively small collections and high circulation figures, when compared to their academic library counterparts. As a result, much of the work being done in the area of profiles is weighted toward the needs of public libraries. If we take the view that at some point in the future, as tag and equipment prices continue to fall, library RFID systems will become ubiquitous, then the needs of other library sectors also need to be factored in. Whether or not communities within different library sectors would actually choose separate combinations of data elements remains to be seen, but it would be useful information when looking to the future.

Contextual profiles

To some extent, library RFID systems in use to date have essentially used the RFID as an “electronic Barcode.” This is to say that suppliers have exploited the ability to read RFID tags without requiring line of sight, therefore enabling the reading of stacked items and items while on shelf etc. What has not been exploited to the same extent is that RFID tags may be written to and rewritten thousands if not tens of thousands of times over. In many cases, there has existed within the library supplier community a mindset that considered tag data to be static; once written never changed. Of course this does not have to be so.

The arrival of ISO/IEC 28560 could be a catalyst for a new approach to this situation. Not only might libraries be able to exercise choice in the selection of data elements to be encoded onto their tags, but also the context in which this choice is made. These contexts might include the life cycle of the item beginning with the acquisitions phase. For example, the new data model standard will support data elements such as “Supplier identifier,” “Product identifier local,” “Product identifier GS1,” “Supply chain stage” and “Order number.” Obviously, each institution will need to examine whether operational value is added by using the RFID tag memory for acquisitions related data, but the point is that it can be done and it could not realistically be done with barcodes.

Hence, the principle to be explored is that RFID tag data does not have to be static. It can be changed to reflect the various life cycle stages or usage contexts of the library material. Such possibilities become even more interesting as we see new products emerging such as smart shelves which may act not only as physical receptacles for collections but can also become RFID readers *and* writers. Products

such as these are now a viable possibility, if only at this stage for small collections and make for some interesting possibilities.

For example, ISO/IEC 28560 will include a data element known as “Shelf location.” This is locally relevant data which maps to a physical location in the library. The conventional thinking is that this element might be read by automatic sorting machines for example to sort collections split over multiple levels etc. However, in a smart shelf context the reverse situation might also be the case. Instead of seeing this element as a static variable that is only read by other devices, the smart shelf could actually *write* the location to the RFID tag. In this way, the dynamic nature of the RFID tag’s memory could allow the library to instruct the shelves to essentially order the sorting machine to relocate a collection, by changing the shelf location codes while the items sat on the shelf. As the items circulated they would progressively be relocated to their new home. Alternatively, the collection could be manually shifted by staff and then the shelves could be instructed to replace the old shelf location with the current position.

The main aspect to this shift in thinking is breaking away from the constraint of the static data mindset and beginning to think about and explore a future where the tag data is what it needs to be at a given point to add operational value.

Inter library loans

Another area that may be a worthwhile candidate for investigation is Inter library loans under RFID. Presently, ILL is often a very manual and labour-intensive process, due to the fact that no common systems exist between the libraries that exchange material. One of the significant advantages of an RFID based infrastructure is that not only are the RFID tags rewritable, but they may also contain more data than can be encoded in a traditional barcode. This raises the question of whether it would be possible to construct an ILL system that is managed by using tag-based data alone.

ISO/IEC 28560 contains a number of data elements that may be useful in this context. In addition to local data fields which may be defined at any level, the standard will also include elements such as “Owner library”, “ILL borrowing institution” and “ILL borrowing transaction number.” While by no means a trivial piece of work, the exploration of process standardisation and automation possibilities using RFID tags in this context could be very useful.

Conclusion

ISO/IEC 28560 represents a great step forward for interoperability between RFID enabled libraries. However, to realise the full benefits of the standard, libraries need to be proactive in establishing what data is needed on the tag, both for local needs and in broader cooperative contexts. Suppliers also should recognise that changes to their circulation-based equipment will be required, to accommodate the inevitable mix of choices that will be made by Australian libraries.

We should also recognise that the arrival of the new standard represents a good time to rethink issues of operational value. Are there contexts in which RFID tag data should change to reflect the context in which the material exists at a point in time?

Are we getting the most from our systems by simply treating the tags as electronic barcodes? Are we so accustomed by convention to a concept of “static data written once and read by many devices” that we are overlooking opportunities available through the dynamic nature of RFID tag memory? Can we envisage ways in which operational value is added by synergy between RFID devices rather than simply between people and RFID devices?

These questions and many more that could be asked are both deliberately provocative and at the same time exciting. There exists great opportunity for suppliers to differentiate themselves in the market by taking a leading role in this area. Because RFID library systems are still evolving, there is also a timely opportunity for forward-thinking library professionals to shape the systems of the future in ways that maximise return on investment and operational value.

References

International Standard Identifier for Libraries and Related Organizations, Structure, retrieved 28 September 2009, from
http://biblstandard.dk/isil/structure.htm

ISO, 2009, Information and Documentation – RFID in Libraries – Part 2: Encoding based on ISO/IEC 15962, retrieved 28 September 2009, from
http://www.iso.org/iso/search.htm?qt=28560&searchSubmit=Search&sort=rel&type=simple&published=on

ISO TC46/SC4/WG11, 2008, ISO 28560 Technical Comments – Structure of the composite standard and frequency issues, retrieved 28 September 2009, from
http://biblstandard.dk/rfid/docs/ISO_28560_Technical_Comments_2008-05-02.htm

Nederlands Normalisatie-instituut, 2007, Application for Data Constructs, retrieved 28 September 2009, from
http://biblstandard.dk/rfid/docs/AFI_Preliminary.pdf