# General RFID

### What is RFID?

Radio Frequency Identification (RFID) is a set of technologies that enables tracking and monitoring activities to be carried out using RFID transponders (often called tags) and invisible radio waves without a line of sight. The read range generally increases with an increase in the frequency used,

Commonly, the technology is employed to track items such as pallets or cartons within a supply chain or warehouse. RFID is also used to identify animals, hospital patients, shipping containers, laundry garments, airline baggage and so on. RFID for libraries is one of the most widely implemented applications.

#### Why RFID in libraries?

RFID systems have been in existence within libraries for many years. Various suppliers claim to have installed the first RFID library system but it's generally accepted that somewhere in the mid 1990's, RFID appeared in a library somewhere in the world. During the last 10 years, usage has accelerated but penetration remains relatively low compared to the total number of libraries. However, the total number of libraries using RFID is significantly greater than in many other sectors, resulting in the fact that the library sector is well beyond the phase of innovators and is certainly well into the phase of early adopters.

RFID's property of non line-of-sight operation can be very useful within a library. If the barcode traditionally used to identify library material is replaced with an RFID tag, the library is immediately able to process multiple items simultaneously and the tag can be located inside the cover in the case of printed material. No longer does every item require individual handling. The resultant benefits to libraries may be seen in the following areas:

- Staff productivity
- Customer service
- Reduced materials handling for staff
- New and improved collection management processes
- Faster and more-intuitive self service options

## What sort of RFID technology is used in libraries?

The first challenge for a developer of library RFID systems is the size and the cost of the tag. Libraries essentially need a smart-label application that can be attached to library material in a relatively unobtrusive way - a passive tag of some sort without a battery. The tag needs to be flexible and durable. In the item security context, the tag needs to be readable over a distance of at least half a metre. Libraries would also like to be able to read tags in a stack of books very quickly so that the productivity of library staff may be improved and the self-service experience of library users may be enhanced.

*The RFID reader technology is built into several equipment pieces specifically for library use. These include:* 

- Staff workstations for issue and returns
- Self service issues equipment designed for the library users
- Security gates for theft detection

- Portable devices for inventory and collection management activities
- Smart returns chutes or bins
- Materials handling and sorting systems

# **RFID Technology & Frequency Issues**

#### Why the debate over frequency for RFID in libraries?

The debate about frequency could not have taken place at the time that the first libraries started to implement RFID systems. Then the only universally acceptable frequency that met operational requirements was 13.56 MHz. In fact there was a mixture of standardised and proprietary technology at that time.

Low Frequency is not really a contender because of the short read range. The other contenders are UHF (860 to 960 MHz), and even RFID protocols at higher frequencies, particularly 2.45 GHz, which seem to have failed to gain a significant market. So let's consider UHF.

The first UHF air interface protocol standard was published in ISO/IEC 18000-6:2004 and this covered two types of tag. It was not until ISO/IEC 18000-6:2004/Amd 1:2006 that the standard was extended to cover Type C tags. These are equivalent to the EPCglobal Class 1 Generation 2 tag specification, around which a lot of exaggerated forecasts were made. For example as ISO 28560 moves forward to publication, the forecasts were that there would be trillions of Type C tags in use. Actually there are possibly more library tags in use as we write than the total production of Type C tags. So hyperbole about this RFID technology, the EPCglobal system itself, and the prediction that tags would cost 5 cents has raised interest in the Type C tag.

What is often not considered are the different characteristics of UHF technology and the architecture of the Type C memory. These include:

- Significantly increased read range not always appropriate
- Different behaviour when the tag is surrounded by organic material: books and people
- A partitioned memory, with many tags still only providing 96 bits for a unique identifier and no other memory
- Tags compliant with ISO/IEC 18000-6:2004/Amd 1:2006 provide no selective locking, even if more memory is provided

On the positive side:

- Faster reading of the RFID tag
- A greater number of tags can be read 'simultaneously'
- Greater immunity to the tag-masking or tag-shadowing problem affecting RFID tags in close proximity

UHF might have a role in future library systems. The working group does acknowledge the interest shown in UHF technology by libraries and also understands that the technology is rapidly evolving. Any decision to support UHF has to be taken after a proper evaluation of the technology and compare it with other options available at the time – for example a new HF technology.

## Why has the ISO working group limited its scope to High Frequency systems?

The purpose of the new ISO standardised data model is to increase the interoperability between RFID systems provided by a range of suppliers. Unfortunately at this stage, there is no interoperability between UHF based systems and systems built around HF technology. This lack of interoperability goes well beyond the data model and involves issues of fundamental technology. Also, the reality today is that the overwhelming majority of currently installed RFID systems around the world are based on HF platforms, particularly ISO/IEC 18000-3 Mode 1.

# Why do the ISO 28560 standards use 13.56 MHz as frequency? Have libraries chosen the wrong technology?

The decision by the vast majority of libraries before the development and publication of ISO 28560 was to support HF technology. This covered some proprietary and some standardised technology. So it is not just an issue of frequency but of specifying a particular air interface protocol. As there has been an increasing focus on using ISO/IEC 18000-3 Mode 1 tags, so the development of ISO 28560 could not ignore this position. ISO 28560 now provides the standardised platform for increased interoperability to enable existing RFID implementations in libraries to migrate to a standardised solution and for new implementations to adopt the standard. The 13.56MHz frequency does offer a number of features that have obviously been considered suitable for RFID for libraries and operating successfully for a number of years. So HF cannot be defined as the "wrong" technology. If, in future, a case is made for considering either a different HF air interface protocol or adopting a different frequency, then the standards will need to be reviewed accordingly.

# When a book is sorted out of the library – do we need to remove the tag or deactivate it?

The simple answer is "NO", both on the basis of the technology and based on custom and practice. The 18000-3 Mode 1 has no features that enable a tag to be rendered temporarily unreadable. Reading can be achieved whenever this type of tag is within a "read zone" of a compatible reader. Custom and practice also makes it sensible for the tag to be readable during the returns process.

# There has been discussion about the potential benefits of using chipless tag technology, what are the implications of this?

There have been many proposed developments of a chipless tag, which are part of a wider trend of printed electronics. There is no doubt that the millions of (whatever currency you like to name) that have been invested in R & D in this area will eventually result in a technology worth considering.

As a press story (August 2011) about a university development cited the chipless tag as the solution for libraries – we won't mention the university here - we need to consider the facts at the time of writing:

• There are fundamentally different technologies being researched to produce the chipless tag.

• The technology is still laboratory based, in terms of replacing conventional RFID.

• The technology is generally proprietary, and protected by patents, which can be a serious impediment to standardisation of the technology.

• By its nature much of the technology is read-only, or encodable only once.

• The tag "promoted" as a solution for libraries has a 24-bit structure. To comply with AFI requirements of ISO 28560, this leaves 16 bits for identifying a loan item, or 65535 different items if the existing human readable identifiers are abandoned.

• But if all the code points are used, then there is no robustness in the system. As a reference the ISBN-13 in its bar code format has a structure that equates to 103 binary bits, which on a like-for-like basis could encode 10141204801825835211973625643008 different codes. However, the GS1 system at the core of ISBN-13 supports only 10 trillion (US counting system) codes. Why this huge difference? Answer: to add robustness to the system with structured encoding

rules and formatting to distinguish this bar code symbology from others. Similar types of rules apply to RFID and are applied at the air interface level and the encoding. One bit of memory is transmitted as multiple bits from the tag to the interrogator.

• For a REAL WORLD application like library circulation it is essential to ensure that there is sufficient robustness in the code structure. It is not evident yet with chipless tags.

If any library wants to take the risk of using a 24-bit code with no capability of rewriting data, not use standards, not have any robustness in the technology to deal with communication noise, then the solution recently being proposed for libraries is right. On the other hand, if libraries want to progress step-by-step to more sophistication – and potentially lower costs – with RFID technology, then stick with the standardised rules for RFID at the technology level in ISO/IEC JTC1 SC31 and at the library application level with ISO TC46.

Eventually, when chipless technology becomes viable, libraries also need to avoid the trap of jumping into a proprietary technology solution which locks them out of interoperability. Almost every – sometimes good – proprietary bar code symbology and RFID technology has fallen by the wayside. Eventually users realise that being locked in with one source of supply is not a good thing.

# **RFID Standards**

# I thought there already was an ISO standard for RFID tags, so what does this new ISO 28560 family of standards change or add?

There are numerous RFID technology standards covering the air interface protocol, the tag architecture, and even the data encoding rules. The new ISO 28560 family of standards adds a completely different dimension. Part 1 defines the data elements, effectively the data dictionary that is used for the application for RFID in libraries. Parts 2 and 3 define different encoding schemes, but both focus specifically on one air interface protocol operating at 13.56MHz (see next answer).

## Why do the ISO 28560 standards use the 13.56 MHz frequency?

ISO 28560 Part 2 and Part 3 both specify the same 13.56MHz air interface protocol which is ISO/IEC 18000-3 Mode 1 (which, in turn, is based on ISO/IEC 15693). This is by far the most common technology currently being used in RFID for libraries. On this basis it made complete sense to provide a migration path from proprietary and national models to an international standard based on the vast majority of existing RFID library implementations.

# My collection contains many RFID tags that are not ISO/IEC 18000-3 Mode 1 compliant. Can this standard be used on those tags?

There are features in ISO 28560 Part 2 and Part 3 that rely upon the use of ISO/IEC 18000-3 Mode 1 compliant tags. If your library uses ISO/IEC 15693 tags these use the same air interface protocol as 18000-3 Mode 1, but it might be relevant to check that the tag supports the commands that are essential for RFID for libraries. For example commands to read and write data are **actually optional in the 15693 standard**.

If your library uses another High Frequency (13.56 MHz) tag, and your RFID system provider intends to support ISO 28560 encoded in 18000-3 mode 1 tags, then there will be methods to distinguish between the types of tag. This vendor-specific method can be used to manage the transition to the new International Standard, but it is more

*likely that ISO 28560 encoding rules might only be possible with the 18000-3 Mode 1 tags. Your supplier can provide more advice.* 

If your library is using a different RF frequency, then interoperability with ISO 28560 will be a significant challenge.

#### I have been hearing about UHF RFID. What about the EPCglobal standards?

UHF and HF (13.56 MHz) technologies are different and not interoperable, so do not provide a cost-effective migration for any library that has already implemented RFID. Like HF there are different UHF standards and it is not clear which is certain to be the dominant technology in the future. Most experts consider that ISO/IEC 18000-6 Type C (also known as EPCglobal Class 1 Gen2) will dominate, but for libraries this might still not be the best solution. Memory is organised in a different way (see answer to "Can ISO 28560 be applied to UHF?") which presents additional challenges. Then to add additional complexity, EPCglobal has also sponsored the development of a new 13.56 MHz standard with the memory structure similar to its UHF tag. The EPCglobal HF standard has yet to be published, but very similar functionality is now provided by the new ISO/IEC 18000-3 Mode 3 technology. Finally, it is not clear which of these tag technologies the book trade will adopt, and when such an adoption might take place. As there are many uncertainties, ISO 28560 is firmly focussed on 13.56 MHz technology.

## Will these standards address tag quality and longevity concerns?

The simple answer is "NO". References are made to a conformance standard for the air interface (ISO/IEC TR 18047-3) and a standard that specifies a method for testing tag performance (ISO/IEC 18046-3). This performance standard defines how to test for some performance parameters, but does set any pass / fail values.

#### What is the life-time of a RFID tag? Will the content disappear in a few years?

The technology standards do not specify an expected life-time. However, the manufacturers of the integrated circuits (the chips) and manufacturers of the RFID tags, which include the antenna, make claims that tags can typically have 10,000 read/write cycles. There have been claims for 100,000 cycles – even 1 million - and a life span of up to 40 years. Anyone purchasing RFID tags needs to check with their vendors on the specific claims being made.

#### Does the use of RFID pose any health problems?

The use of RFID is governed by strict regulations on the power that may be emitted at the given frequency. This is the power is emitted by the reader and the tags themselves have no power source and only function in proximity of a reader. The regulations vary between regions and countries around the world, but for 13.56MHz technology they are considered to be comparable and safe.

In some regions, a distinction is made between the safety levels that apply to staff and members of the public. The exposure to staff using RFID is normally set at higher limits, because the expectation is that safety regulations will be covered in staff training. For members of the public, the extent of exposure has to be lower because the health conditions to the individual is unknown and their knowledge of RFID is considered to be lower. Safe use by staff of RFID and design of RFID self-service systems should mitigate any risks.

### Will the price for RFID tags fall in the future?

There are two factors that can contribute to a reduction in the price of a tag, and two factors that might keep prices at the same level or even higher. The price of tags for 18000-3 Mode 1 could come down if market forces prevail. Currently, RFID for libraries

presents the largest single marketplace for RFID, but libraries are not necessarily exercising their purchasing power as the largest customer base for the tags. Another point that can contribute to a price reduction, is that the particular type of tag being specified in ISO 28560 has been available for some time. This means that research and development costs should have been recovered and price can move to a cost-ofproduction basis. This is quite complex to achieve, because the RFID integrated circuit manufacturers are also spending R&D resources on new tag technology. If the customer base fails to exercise its opportunities with respect to supply and demand, then there is no incentive for manufacturers to reduce the price. Prices might increase because of the increased price of commodities that are used to make the RFID tags. Finally, a word of caution: the standards specify basic rules but manufacturers make products to a specification. So it is important to ensure that tags are of a sufficient quality for use in the application.

## Can ISO 28560 be applied to UHF?

The data elements, specified in ISO 28560 Part 1, are generally independent of any RFID technology issues including data encoding. Whatever decision is made to support any different tag technology – even a different 13.56 MHz air interface protocol, a significant review would need to be undertaken. To introduce UHF technology as a migration from either ISO 28560 Part 2 and / or Part 3 will most likely require additional parts to be added to the ISO 28560 family.

## Adoption & migration

## Do I need to migrate to this standard?

There is no requirement to migrate to ISO 28560, and its two different encoding rules. However, a number of vendors have undertaken development to support the standards and there is an increasing interest in achieving interoperability. The choice still remains with each library.

## How can I be sure not to violate privacy?

This is a complex area, and subject to national and even regional law (for example across the European Union). Generally such law applies to all of RFID.

The key point to note, at the time of writing, is that there are many different RFID library systems in operation and not being challenged by the relevant authorities. There are a number of misunderstandings about privacy and RFID, both from the lobbyist community concerned about privacy and from the vendor community. The issue is not simply about RFID technology, but the entire RFID system. There are additional considerations in the entire library system that is subjected to other legal requirements such as data protection. Earlier this year, the European Commission circulated a consultation document and the European library community responded to this. As developments take place, this website will provide updated information.

# As technology changes, how can we be assured that all systems with be backward compatible?

There is no guarantee that all systems will be backward compatible with any future changes. On a more positive note, the standards have been written in a way that provides the same potential for moving forward with changes in technology, as have been supported for the migration from proprietary and national models to ISO 28560. The most fundamental change in technology will be the introduction of a new air interface protocol. When the library community, through their national standards

bodies, express that a new technology needs to be considered, ISO TC46 SG4 WG11 RFID for Libraries will give the matter serious consideration and widespread consultation.

There will also be ongoing technology changes associated with the particular air interface protocol. If these are standardised, then they will be considered but libraries need to be aware that if vendors introduce proprietary features, these might be detrimental to interoperability for inter-library loan purposes, and even interoperability of devices.

# ISO 28560 Standards Issues

I see that ISO 28560 has 3 component parts. What are the differences between the parts? Why are there 3 parts?

The three parts meet different requirements:

**Part 1: Data elements and general guidelines for implementation** defines the data elements and will be relevant irrespective of how the data is encoded on the tag and even which tag technology is used. It will be revised as new data elements are agreed to be added to the standard.

**Part 2: Encoding of RFID data elements based on rules from ISO/IEC 15962** makes use of generic RFID encoding rules that provide the flexibility just to encode the one mandatory data element or to select any of the optional data elements. It is possible to selectively lock any data element.

**Part 3: Fixed length encoding** provides for a migration from some of the existing national fixed length encoding schemes, particularly the Danish model. There are a number of mandatory data elements in the basic 'encoding' block. The standard is silent about locking, but generally this needs to be applied to an entire block.

# If there are 2 compliant data models, do the vendors' products need to support both to be compliant with the standard?

Conformance requirements for ISO 28560 Part 2 and Part 3 are different. This has been covered by the conformance "Conformance Guidelines ISO 28560. RFID in Libraries".

These documents make it clear that conformance between the two standards is independent. It is possible to claim conformance to just part of the process, for example, for encoding the tag but not necessarily for decoding the tag and vice versa. The intention is to provide different types of vendors with the greatest amount of flexibility to support the library community with interoperable devices. A top class company that only manufactures printer encoders will be able to consider claiming conformance.

Major vendors of complete library RFID systems, when assessing the market will most likely support both standards.

# Is an RFID system strictly tied up to one of the two encoding specified in ISO 28560, or will it be able to handle tags independent of the chosen encoding?

If a vendor decides to support both encoding schemes, then various "software switches" can be used to automatically process individual tags encoded to one or other scheme.

An alternative approach is for a vendor to primarily support one encoding scheme, but use the same type of software switches to divert to the data from tags based on the other encoding scheme to a parallel set of software.

### What is AFI?

AFI stands for Application Family Identifier. ISO/IEC 15961 (and later revisions still in development by ISO) use the AFI as a tag selection mechanism across the air interface. This means that if a library book is taken into a different environment where a different AFI has been assigned for that application; there will be no system clash with the library loan item being confused with the other application system. The same applies in reverse with a tag coming from another environment into a library. It is for this reason that an application for a specific AFI was made early on in the process, so that existing proprietary and national models could adopt the correct AFI as early as possible.

#### Which values of AFI do we need to use?

ISO 28560-1 clarifies that one or two AFIs may be used, depending on how the security system works in a particular library.

A library shall at least use a single AFI, the value  $C2_{HEX}$  assigned under the registration of ISO/IEC 15961-2. This distinguishes library items from all others, and avoids the risk of an RFID reader in another domain reading the RFID tag on a loan item and confusing its encoded content with data in an application outside the library domain.

The AFI may additionally be used as part of an "item security system" where the AFI value  $C2_{HEX}$  is written to tags for items that are on loan to a client. When the books are returned, the in-stock AFI value  $07_{HEX}$  is written to the tag.

#### What do I need to consider about character sets?

ISO 28560 Part 1 specifies the data element and constraints on some of the characters that can be used for encoding that data element. These rules are carried through into the encoding of Part 2 and Part 3, but with some subtle differences (see the details below).

#### What is an ISIL?

ISIL is an acronym for International Standard Identifier for Libraries and Related Organizations The rules are defined in ISO 15511 Information and documentation -International Standard Identifier for Libraries and Related Organizations (ISIL). The rules define a method for identifying libraries, archives and museums. The data elements: Owner institution (ISIL) and ILL borrowing institution (ISIL) use ISIL to identify the library. The ISIL may take one of two forms:

*a)* using a country code prefix to identify a national ISIL agency

*b)* using a different prefix to identify a non-national agency, for example OCLC has registered the WorldCat Symbol

## What if the ISIL is a WorldCat Symbol – is "OCLC" needed as prefix?

The answer is no. Code O (letter) for OCLC can be used as prefix for technical encoding of WorldCat Symbol in e.g. RFID tags.

#### What is an ISIL don't fulfill the ISO 15511 ISIL requirement to characters?

There are situations where a WorldCat Symbol assigned by OCLC contains characters that are not permitted by ISO 15511, and therefore cannot be encoded in a manner that conforms to ISO 28560 for data element 3 Owner institution (ISIL) and data

element 11 ILL borrowing institution (ILL). For an owner library affected by having such an WorldCat Symbol, these options are available:

- Approach OCLC to request an alternative WorldCat Symbol that fully complies with ISO 15511.
  - NOTE: It is understood that future assignments of OCLC codes will comply with ISO 15511.
- Approach the national ISIL allocation agency to have an alternative ISIL, which can be encoded in data element 3 Owner institution (ISIL).
- Use data element 23 Alternative owner institution, and encode the WorldCat Symbol here.
- Use data element 23 Alternative owner institution and prefix the WorldCat Symbol with the two characters "O=" to signal that it is an WorldCat Symbol (not to be mix up with "O-" as prefix and separator in data element 3).

For a lending library in ILL transactions, WorldCat Symbols that do not comply with ISO 15511 shall be encode in data element 25 Alternative ILL borrowing institution and not in data element 11 ILL borrowing institution (ILL). This is because the lending institution has no control of the ISIL of the borrowing institute.

# Should I consider locking the data? What should I be thinking about when I decide which way to go on this issue?

The ISO/IEC 18000-3 Mode 1 tag has a facility to selectively lock blocks of data. A block is a fixed number of bytes for a particular tag model and typically is either 4 bytes or sometimes 8 bytes long. Once a block is locked, it can never be unlocked. So this is the first point for a library to consider. A further challenge is that, based on the encoding rules, a library might not know which data elements can be locked or not. Locking capabilities for Part 2 and 3 are discussed below.

## Do we need to encrypt some of the data on the tag – and how?

None of the data elements are specified as requiring encryption. This is because the 18000-3 Mode 1 tag provides no method to store an encryption key in a separate memory area. In addition, although encryption without such a separate memory is theoretically possible, the keys will either need to be encoded with other data or need to be exchanged between stakeholders, particularly for interlibrary loans. If a data element is considered sensitive in a particular domain, then it should not be encoded on the tag.

# I have heard that I might need to "refresh" the data in my RFID tags periodically, is this so?

Various technical experts have been consulted on this point, and there is a slight disagreement in their views. One view is that refreshing is necessary because there is a gradual reduction in power capabilities as time goes by. Other experts say that it does not matter, and the very action of reading and writing tags actually achieves an element of "refreshing". There are a number of RFID discussion platforms that raise various issues about RFID in libraries, and this does not seem to have been a significant issue in the discussions whereas many other topics have.

## Will the new standard address item security?

*Part 1has a complete annex devoted to security, effectively anti-theft, issues and covers three main types of security mechanism:* 

• Using a dual AFI, where the security implementation is based on an AFI code with the value 07HEX programmed as the AFI code for library items that are checked into the collection. It also requires that AFI code C2HEX is encoded on items that are checked out and on loan.

- Using the tag's unique chip identifier and a database compiled with the tag IDs of items that are checked out of the library. The security system is programmed to read all tag ids, look them up in the database and, if they are not in the database of authorised checked-out items, the assumption is that they have been removed in an unauthorised manner. The database only needs to hold tag ids that have recently been checked out.
- Using electronic article surveillance (EAS) features have been added by some manufacturers of ISO/IEC 18000-3 Mode 1 tags as a proprietary feature. As such, the operation of this feature is outside the scope of the ISO/IEC 18000-3 Mode 1. It is included here because a number of vendors offer this as a feature of their system. Interoperability between different EAS systems cannot be assumed.

#### How are new elements added to ISO 28560?

Five of the data elements are "Reserved for future use". The ISO working group (ISO TC46/SC4/WG11) has decided a procedure for assigning these elements for specific use. If you identify the need for a new data element, contact your the national member body of ISO. This body can send a proposal for use of a reserved element to the Convener of ISO TC46/SC4/WG11 RFID in libraries.

A proposal shall include name of the element and its definition for including in ISO 28560-1 and a description of intended use and reasons for use on international level. In addition there need to be proposed encoding rules for ISO 28560-2 and ISO 28560-3. Then the editors of ISO 28560 will submit the proposed additions to WG11. It will also be a formal proposal to be added to ISO 28560 when the next update of the standard are carried out, especially as it has previous acceptance within WG11.

This procedure ensures that a general need for a new element can be fulfilled in short time.

## ISO 28560-2 Specific Issues

#### How can I migrate to the ISO 28560-2 standard? Will I need to re-tag my collection?

There are two main migration paths to ISO 28560-2. In the short term, the more likely path is from a proprietary coding scheme to the standard. The data encoding is completely different and libraries need to consider whether a national or other data model is in place for ISO 28560-2. The other path is from an existing national data model, where again the encoding is complete different.

Encoding to 28560-2 requires the appropriate AFI and DSFID to be encoded. This enables tags compliant with the ISO standard to be distinguished from previous encoding schemes. A specific consideration is that tags that were previously locked might not be able to be converted. In this case it might be necessary to re-tag the particular loan item. Generally if none of the previous data has been locked, then retagging is less likely.

#### Do I need to use all data elements, and if not, do I need to make a profile?

No. The only mandatory data element is the Primary Item Identifier. However, consideration needs to be given to the possibility of national or regional data profiles being in place.

## What do I need to consider about character sets?

The encoding for Part 2 has ISO/IEC 8859-1 as the default character set. There are also special rules for encoding some data elements. There are four data elements (title

and the three locally defined data elements in ISO 28560 that may be encoded to support languages other than the Latin alphabet. In this case UTF-8 is required to encode these data elements, then this needs to be explicitly indicated in the encoding process.

#### Does it matter in what order the data elements are encoded on the tag?

Part 2 only requires that the primary item identifier is encoded in the first position, but recommends that the content parameter is encoded in the second position (but even this is not mandatory). Part2 then allows complete flexibility for the selection and order of the data elements. This is possible because of the flexibility offered by the ISO/IEC 15962 encoding rules.

#### What should I consider about locking the data?

Part 2 addresses locking by enabling a library to choose which individual data elements are to be locked and then leaving the encoding process to deal with the technical organisation so that blocks are locked on the tag. Three data elements should never be locked. These are the ones that are associated with any inter-loan library transaction: ILL borrowing institution (ISIL), ILL borrowing transaction number, and Alternative ILL borrowing institution

## ISO 28560-3 Specific Issues

### How can I migrate to the ISO 28560-3 standard? Will I need to re-tag my collection?

There are two main migration paths to ISO 28560-3. In the short term, the more likely path is from a national coding scheme, for example the Danish model, to the International standard. The basic block of ISO 28560-3 is the same as the Danish model. Other pre-existing national models might be different. ISO 28560-3 has additional block for the encoding that the library might decide to encode. The other path is from a proprietary encoding scheme, where the encoding is complete different from 28560-3.

Encoding to 28560-3 requires the appropriate AFI and DSFID to be encoded. This enables tags compliant with the ISO standard to be distinguished from previous encoding schemes. A specific consideration is that tags that were previously locked might not be able to be converted. In this case it might be necessary to re-tag the particular loan item. Generally if none of the previous data has been locked, then re-tagging is less likely.

### What's the difference between the Danish Data Model (DS/INF163) and 28560-3?

The data elements in ISO 28560-1 are backward compatible with the Danish Data Model (DDM). All data elements in DDM are carried on in ISO 28560-1. Also the encoding described in ISO 28560-3 is backward compatible with DDM. A few details are added in ISO 28560-3. This is described in ISO 28560 and DS/INF 163

### Do I need to use all data elements. And if not, do I need to make a profile?

The data elements in the basic block are the core data elements for inventory control and circulation. The other blocks contain data elements for acquisition, ILL, title and library supplement. You can pick the data elements you need. If you use more than the basic block, it is recommended to define a profile (See Annex E and section 7 in ISO 28560-1).

### What do I need to consider about character sets?

The default character set for strings of data for Part 3 is UTF-8. In addition, specific encoding rules are applied to some data elements.

#### Does it matter in what order the data elements are encoded on the tag?

Part 3 first puts the data elements into sets (known as blocks – not to be confused with the block structure of the memory on the RFID tag itself) and then, within each block, specifies the sequence of the data elements. The basic block is mandatory, and has a defined set of data elements. Part 3 also specifies a number optional of structured extension blocks, each with a defined structure, but with the capability of not encoding some of the data elements defined for the block.

## What should I consider about locking the data?

Part 3 does not prescribe any strategy for locking. Such a strategy is left for regional profiling.

It should be noted that the structure of the basic block means that no individual data element may be locked and only the entire block may be locked.

#### How does the validation check work?

When an RFID tag is written, a checksum is calculated and stored as part of basic block. When a tag is read, the same calculation is done. If the checksum calculated by the reader differs from the stored checksum, an error has occurred, and the tag should be inspected. The reason may be an error on the tag, e.g. wrong encoding scheme, or an error in the reader. The validation method is CRC – Cyclic redundancy check (See Annex C).