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Information and documentation — RFID in libraries —

Part 2: Encoding of RFID data elements based on rules from ISO/IEC 15962

Information et documentation — RFID dans les bibliothèques — Partie 2: Encodage des éléments de données RFID fondé sur les règles de l'ISO/CEI 15962

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 46, *Information and documentation*, Subcommittee SC 4, *Technical interoperability*.

This third edition cancels and replaces the second edition (ISO 28560-2:2014), of which it constitutes a minor revision. The changes compared to the previous edition are as follows.

— The data elements that require the ISO/IEC 15962 application-defined compaction have been identified in Table 1. There are no changes to the actual compaction rules that are applied.

— The correct object Identifier registered with ISO/IEC 15961-2 has been provided (see 7.2.4). This has no impact on encoding on the RFID tag itself and is only relevant if a full OID structure is used, for example, with a browser.

— A publication error has been discovered in the second edition (ISO 28560-2:2014), where Table C.3 has been deleted. This table has been re-instated.

— References have been modified (see 5.3 and 6.4) to clarify that Annexes B and C, respectively, are normative.

— The text has been amended (in 7.4.5.1) to clarify that only some of the ISO/IEC 15962 encoding rules are relevant to this document.

— Withdrawn references to specific RFID protocol parameter codes (see 8.1.2) have been removed. The rules defined in 8.1.2 remain unchanged.

— References to ISO/IEC JTC 1 SC 31 have been removed.A list of all parts in the ISO 28560 series can be found on the ISO website.

A list of all parts in the ISO 28560 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Libraries are implementing radio frequency identification (RFID) as item identification to replace bar codes. RFID streamlines applications like user self-service, security, and materials handling. A standard data model for encoding information on RFID tags could increase the cost-effectiveness of the technology within libraries, particularly through greater interoperability of RFID tags and equipment, and enhance support for resource sharing between libraries.

Several countries have undertaken preliminary work on standardization. The Netherlands developed a data model for public libraries and in Denmark "RFID Data Model for Libraries" has been published. Finland has adopted the Danish model, but with a few changes. There is a French data model that differs from the Danish and Dutch models. Other libraries in different parts of the world have installations based on various proprietary systems offered by technology and library system suppliers. All of these constitute the installed base of RFID systems, but only account for a small minority of the total of libraries globally.

There is an opportunity to develop a standard data model, taking into account the lessons learned from the national schemes and vendor solutions, and provide migration options for those libraries that have already invested in the technology. Because new items are continually being purchased, a number of migration options can be adopted based on factors relevant to each library.

This document deals with the encoding of data elements in a flexible manner using encoding rules that are specified in ISO/IEC 15962. ISO 28560-1 defines the set of mandatory and optional data elements.

ISO 28560-3 and this document are mutually exclusive with respect to an RFID tag being applied to a loan item. In other words, the RFID tag is encoded according to the rules of this document, or to the rules of ISO 28560-3, or to some proprietary rules. Depending on the technologies being used, and other features of tags that are claiming conformance with this document, the reading system might achieve a degree of interoperability.

This document provides essential standards-based information about RFID in libraries. Ongoing advice needs to be provided because of the evolving nature of RFID technology, and the opportunities to migrate between different types of legacy system and encoding rules of this document.

Information and documentation — RFID in libraries —

Part 2: Encoding of RFID data elements based on rules from ISO/IEC 15962

1 Scope

This document specifies a data model and encoding rules for the use of radio frequency identification (RFID) tags for items appropriate for the needs of all types of libraries (including national, academic, public, corporate, special, and school libraries). The rules for encoding a subset of data elements taken from the total set of data elements defined in ISO 28560-1 are based on ISO/IEC 15962, which uses an object identifier structure to identify data elements.

This document defines the technical characteristics required to encode the data elements defined in ISO 28560-1 in accordance with ISO/IEC 15962. These subsets of data elements can be different on different items in the same library. The encoding rules also enable the optional data to be organized on the RFID tag in any sequence. In addition, the encoding rules provide for flexible encoding of variable length and variable format data.

This document provides essential standards-based information about RFID in libraries. A source of additional information about implementation issues is provided in Annex A.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 15961-1, *Information technology — Radio frequency identification (RFID) for item management: Data protocol — Part 1: Application interface*

ISO/IEC 15962, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: data encoding rules and logical memory functions*

ISO/IEC 18000-3, *Information technology — Radio frequency identification for item management — Part 3: Parameters for air interface communications at 13,56 MHz*

ISO/IEC 18046-3, *Information technology — Radio frequency identification device performance test methods — Part 3: Test methods for tag performance*

ISO/IEC TR 18047-3, *Information technology — Radio frequency identification device conformance test methods — Part 3: Test methods for air interface communications at 13,56 MHz*

ISO 28560-1, *Information and documentation — RFID in libraries — Part 1: Data elements and general guidelines for implementation*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
access method
component of the *DSFID* (3.8) that is responsible for declaring the ISO/IEC 15962 compaction and encoding rules on an RFID tag

3.2
air interface protocol
rules of communication between an RFID interrogator and the RFID tag of a particular type, covering: frequency, modulation, bit encoding, and command sets

3.3
application command
instruction issued from the application to the ISO/IEC 15962 data protocol processor in order to initiate an action or operation with the RFID tag(s) via the interrogator

3.4
AFI
application family identifier
mechanism used in the data protocol and the *air interface protocol* (3.2) to select a class of RFID tags relevant to an application, or aspect of an application, and to ignore further communications with other classes of RFID tags with different identifiers

3.5
arc
specific branch of an object identifier tree, with new arcs added as required to define a particular object

Note 1 to entry: The top three arcs of all object identifiers are compliant with ISO/IEC 9834-1, ensuring uniqueness.

3.6
data format
mechanism used in the data protocol to identify how *object identifiers* (3.11) are encoded on the RFID tag, and (where possible) identify a particular data dictionary for the set of relevant object identifiers for that application

Note 1 to entry: The data format declares the *Root-OID* (3.13) in an efficient manner, so that a complete *object identifier* (3.11) can be reconstructed for external communications.

3.7
data protocol process
implementation of the processes defined in ISO/IEC 15962, including data compaction, formatting, support of the command/response unit, and an interface to the tag driver

3.8
DSFID
data storage format identifier
code that consists of, at least, the *access method* (3.1) and *data format* (3.6)

3.9
digital vandalism
unauthorized modification of data on an RFID tag that either renders it unusable or falsely represents another identifier

3.10
metadata
type of data or information about data

Note 1 to entry: In the context of this document, *metadata* (3.10) can be the *Relative-OID* (3.12) in relation to the data, the precursor in relation to the compacted and encoded bytes, or the *AFI* (3.4) and *DSFID* (3.8) in relation to the data.

3.11
object identifier
value (distinguishable from all other such values), which is associated with an object

3.12
Relative-OID
particular *object identifier* (3.11) that constitutes the remaining *arcs* (3.5) after the *Root-OID* (3.13)

3.13
Root-OID
particular *object identifier* (3.11) that constitutes the first, second, and subsequent common *arcs* (3.5) of a set of object identifiers (hence the common root)

3.14
tag driver
implementation of the process to transfer data between the data protocol processor and the RFID tag

4 Applicability and relationship with other systems

4.1 Figure 1 gives an overview of the relationship of this document with other systems. This document defines a set of technical features while addressing a number of operational issues. This document interfaces with four other activities, but with a clearly defined overlap. These other activities are

— the circulation of library materials,

— the data requirements of publishers, printers, and other suppliers,

— the interlibrary loan processes, and

— the details of borrowers, including membership cards.

4.2 Figure 1 also shows that there is a direct relationship with supply chain activities, and internally within the library with RFID circulation devices and the library management system including interfaces such as SIP2 and NCIP.

As the use of RFID in libraries moves towards a more standardized approach as defined in this document, the characteristics and architecture systems change compared to those already established.

To achieve interoperability with equipment and software, the required features include:

— the air interface protocol, which defines the way readers and tags communicate with one another;

— the data protocol, which defines the encoding rules that convert application-based data to the encoded bytes on the RFID tag; the data protocol also defines metadata features in the RFID tag to protect the integrity of RFID for library systems in relation to other RFID applications;

— the set of data elements that form the dictionary from which individual libraries can choose those that are most appropriate for their operation.

4.3 By adopting this document, libraries will have increased flexibility with a number of features as follows.

— Beyond the minimum of mandatory data elements defined in this document, libraries are able to choose from the optional data elements those that are more appropriate to its application, even varying these for different types of item.

— Libraries should be able to rank the optional data elements into an appropriate order for encoding on the RFID tag to support fast transactions across the air interface.

— Libraries have a greater choice of interoperable RFID equipment, and should be able to select RFID tags with an appropriate size of memory.

— Some degree of choice in the types of security system becomes a library responsibility.

— Libraries with an installed base of RFID data capture is offered options on how to migrate to the more open standard solution.

— The library community, as a whole and through developments of this document, is provided with future options to cope with changes within the RFID equipment as the technology develops. This includes ensuring that new open systems applications do not corrupt the established base of RFID systems in libraries.

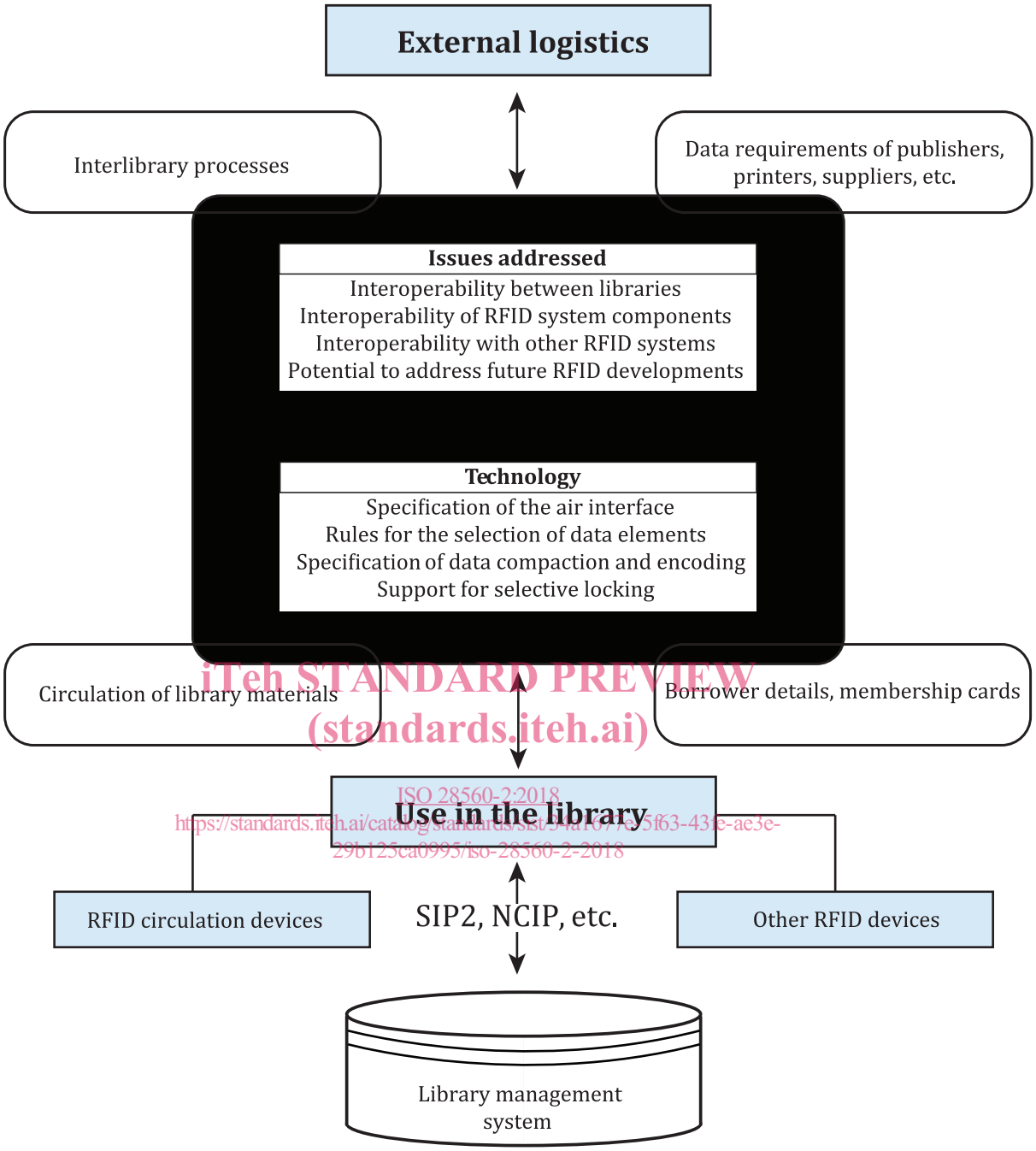

Figure 1 — Relationship of this document with other systems

5 Requirements

5.1 Data elements

The data elements shall be compliant with ISO 28560-1.

NOTE There is a degree of flexibility in using locally defined codes that enable enhancements and variations to be implemented while still complying with the basic set of data elements.

5.2 RFID air interface

5.2.1 General

The air interface for compliant tags is specified in ISO/IEC 18000-3, especially the specification for Mode 1.

For migration purposes, additional non-compliant air interfaces used in legacy systems can be supported during a transition period, which is permitted to remain in place for years as necessary.

5.2.2 Air interface conformance

The air interface conformance shall be tested in accordance with the procedures of ISO/IEC TR 18047-3.

5.2.3 Tag performance

Where there are requirements for testing tag performance, these shall be done in accordance with ISO/IEC 18046-3.

5.3 Data protocol

ISO/IEC 15961-1 specifies the application commands that shall be used to define the communication requirements between the application and the RFID tag. The relevant commands are specified in Annex B.

The process rules of ISO/IEC 15962 shall be used to encode and decode data from the RFID tag. In particular, the following constraints shall apply.

— The only encoding rules shall be based on the No-directory access method. No alternative access method shall be supported until this document is revised.

— Both the hard-coded and software-encoded DSFID shall be supported, depending on the capabilities of the RFID tag.

5.4 RFID readers

In order to achieve interoperability, RFID readers shall be based on open architecture RFID standards. Particular standards are specified in this document. This means that any one manufacturer's reading/writing equipment shall be able to read or write to any other manufacturer's RFID tags, and that any manufacturer's RFID tags shall be able to be read and/or programmed by any other manufacturer's reader/writer.

6 Data elements

6.1 General

The set of data elements that comprises the data dictionary for this document is fully described in ISO 28560-1 and repeated in outline in Table 1. Only one data element is mandatory, the primary item identifier. All others are optional, but can be selected to meet the requirements of individual libraries, and/or for particular items.

Table 1 shows the Relative-OID value, the format for input data, and advice about locking the data element as an encoded data set on the RFID tag. A maximum length of 255 characters should apply to all data elements that have a variable length display format.

Table 1 — List of data elements

N[a]	Name of the data element	Status	Display format	Lock
1	Primary item identifier	Mandatory	Variable length alphanumeric Character set = ISO/IEC 646 International Reference Version (IRV)	Should be locked
2[c]	Content parameter	Optional	Bit mapped code (see 6.3)	Optional
3[b,c]	Owner institution (ISIL)	Optional	Variable length field (maximum of 16 characters) based on ISO 15511	Optional
4	Set information	Optional	{Total in set/part number} structure (maximum ≤ 255)	Optional
5[c]	Type of usage	Optional	Single octet (coded list)	Optional
6	Shelf location	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV	Optional
7	ONIX media format	Optional	Two uppercase alphabetic characters	Optional
8	MARC media format	Optional	Two lowercase alphabetic characters	Optional
9	Supplier identifier	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV	Optional
10	Order number	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV	Optional
11[b,c]	ILL borrowing institution (ISIL)	Optional	Variable length field (maximum of 16 characters) based on ISO 15511	Not locked
12	ILL borrowing transaction number	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV	Not locked
13	GS1 product identifier	Optional	Fixed length 13 numeric digit field	Optional
14	Alternative unique item identifier	Reserved for future use		—
15	Local data A	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV, ISO/IEC 8859-1, or UTF-8	Optional
16	Local data B	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV, ISO/IEC 8859-1, or UTF-8	Optional
17	Title	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV, ISO/IEC 8859-1, or UTF-8	Optional
18	Product identifier local	Optional	Variable length Alphanumeric Character set = ISO/IEC 646 IRV	Optional
19[c]	Media format (other)	Optional	Single octet (coded list)	Optional
20[c]	Supply chain stage	Optional	Single octet (coded list)	Optional
21	Supplier invoice number	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV	Optional
22	Alternative item identifier	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV	Optional
23	Alternative owner institution	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV	Optional

[a] This column specifies the data element number (*N*) or the Relative-OID value, i.e. the number identifying the data element, as defined in ISO 28560-1.

[b] The ISIL, as used for Relative-OID values 3 and 11, is presented and displayed according to the characters defined in ISO 15511. A special encoding scheme, as defined in 6.4, is used to compact efficiently the complex ISIL character string.

[c] These data elements require the ISO/IEC 15962 application-defined compaction to preserve the integrity of some pre-processing that has been applied to them.

Table 1 *(continued)*

N[a]	Name of the data element	Status	Display format	Lock
24	Subsidiary of an owner institution	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV	Optional
25	Alternative ILL borrowing institution	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV	Not locked
26	Local data C	Optional	Variable length alphanumeric Character set = ISO/IEC 646 IRV, ISO/IEC 8859-1, or UTF-8	Optional
27	Not defined	Reserved for future use	—	—
28	Not defined	Reserved for future use	—	—
29	Not defined	Reserved for future use	—	—
30	Not defined	Reserved for future use	—	—
31	Not defined	Reserved for future use	—	—

[a] This column specifies the data element number (*N*) or the Relative-OID value, i.e. the number identifying the data element, as defined in ISO 28560-1.

[b] The ISIL, as used for Relative-OID values 3 and 11, is presented and displayed according to the characters defined in ISO 15511. A special encoding scheme, as defined in 6.4, is used to compact efficiently the complex ISIL character string.

[c] These data elements require the ISO/IEC 15962 application-defined compaction to preserve the integrity of some pre-processing that has been applied to them.

6.2 Primary item identifier

The primary item identifier is a mandatory data element defined in ISO 28560-1.

This is the only mandatory data element that is required to be encoded to be compliant with this document. The format is variable length, and the alphanumeric characters can be any from ISO/IEC 646 International Reference Version (also known as US-ASCII). Although the encoding rules support any length of primary item identifier, shorter codes and all-numeric codes encode more efficiently, requiring less memory and enabling faster transactions across the air interface. Although locking the primary item identifier is optional, under normal circumstances, this data element should be locked to prevent various forms of digital vandalism. The primary item identifier shall be encoded as the first data element on the RFID tag to allow for faster transactions across the air interface by invoking a Read-First-Object(s) argument in the read command (see B.5).

6.3 Content parameter

The content parameter is an optional data element used to declare the Relative-OID values that are encoded on the RFID tag, and for the purposes of this document is used as an OID index. It should be used if additional data elements are encoded on the RFID tag. If used, it can be an aid to faster reading, because it indicates the presence or absence of a particular data element. If the desired data element is encoded on the tag, then additional reading is required, whereas if the OID index indicates that it is not on the tag, the wasted transaction time can be eliminated.

The index, itself, consists of a bit sequence, where each bit position is associated with a particular Relative-OID. If the bit position is set “1”, then the Relative-OID and associated data object is encoded on

the RFID tag. As Relative-OID 1 is mandatory and Relative-OID 2 is this particular data element, the bit map begins at Relative-OID 3. An example is shown in Figure 2.

Relative-OID	3	4	5	6	7	8	9	10	11							
Bit 1 = encoded	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0

Key

padded bits to indicate not encoded or not applicable (rounded to 8-bit boundaries)

Figure 2 — Example of OID index bit map

In the example in Figure 2, the OID index indicates that Relative-OID values 3, 8, and 11 are encoded. Irrespective of whether the data dictionary includes other Relative-OID values, the bit map can be truncated at this last Relative-OID that is encoded. It is also necessary to round up the bit map to 8-bit boundaries for encoding on the RFID tag.

If this data element is encoded on the RFID tag, it should be in the second position so that the data capture system can be set up to read the primary item identifier and the OID index in a single read process. The OID index should only be locked if the information on the RFID tag is certain to remain unchanged. This data element provides no information about the sequence of the encoded data elements, nor their size. In the example in Figure 2, the encoding sequence could be Relative-OID value 8 followed by 11, followed by 3.

6.4 Owner institution (ISIL)

The owner institution data element represents the ISIL code as specified in ISO 15511. For this document, the ISIL code is introduced into the RFID encoding process in a structure defined in accordance with the rules of ISO 15511. This means that the hyphen (present in every ISIL code following the two-character country code) is presented in the application commands.

To achieve efficient encoding, the ISIL shall be pre-encoded to rules defined in Annex C. This Annex also applies to the ILL borrowing institution (6.12). In addition to providing details of the encoding scheme, Annex C also provides advice about interfacing with ISO/IEC 15962 encoders and decoders.

The use of these codes assumes (for example) an external interlibrary loans (ILL) system capable of tracking the item based on the unique combination of its primary item identifier and owner institution. This element is optional where items are not included in an ILL scheme but required when items are required to be issued on ILL using RFID. While it might be deemed necessary to lock this data element, this is left optional as some libraries can choose to leave the data element unlocked so that it could be changed if necessary as a result of library mergers or transfer of collections, etc. Other applications can also make use of the ISIL.

6.5 Set information

The set information is presented in two components, which are

a) the total number of parts, and

b) the ordinal part number, with a maximum of 255 parts.

ISO 28560-1 defines various examples of encoding, particularly where not all the parts of the set carry an RFID tag.

If the total number of parts is 9 or less, then the user data can be presented as a two-digit code to reduce the encoding requirement. If the total number of parts is between 10 and 99, then the user data are presented as a four-digit code, with the lowest ordinal values shown as 00 to 09. If the total number of parts is between 100 and 255, then the user data are presented as a six-digit code. If the ordinal value is less than 100, it is prefixed by leading zeros to create a three-digit number.