TECHNICAL REPORT

ISO/IEC TR 24710

First edition
2005-10-15

Information technology — Radio frequency identification for item management — Elementary tag licence plate functionality for ISO/IEC 18000 air interface definitions

Technologies de l'information — Identification de radiofréquence pour la gestion d'objets — Fonctionnalité du numéro matricule utilisant des tags élémentaires pour les définitions de l'interface d'air pour l'ISO/CEI 18000

Reference number
ISO/IEC TR 24710:2005(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

In exceptional circumstances, the joint technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC TR 24710, which is a Technical Report of type 3, was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

Introduction

ISO/IEC 18000 (all parts) defines the operation of radio frequency identification (RFID) air interfaces for item identification and management.

ISO/IEC 18000 has been designed to encompass a full range of data capture and carrier functionality. Both read and write operations are enabled, and the interfaces can efficiently support both simple and complex data transactions.

This approach facilitates user implementation by providing consistency between differing types of RFID data transactions. Equally it provides architecture to guide future RFID development whilst maintaining the backward compatibility necessary to sustain market confidence.

Recent developments in the design and management of distributed databases holding item level information have focused attention on “identification data element” operation of RFID systems. In this application, the RFID tag carries only sufficient data to permit reference to attribute information held elsewhere. Typically this data does not change during the validity of the “licence” and is of relatively low bit count.

This Technical Report has been prepared to assist users intending to implement ISO/IEC 18000 RFID air interface standards, with particular focus on so-called elementary tags, i.e. tags possessing limited memory — typically but not exclusively 256 bits or less — and lacking write capability (but not excluding WORM devices).

The annexes to this Technical Report describe the implementation of ISO/IEC 18000-2, -3, -4, -6 and -7 in such an application.

Users are strongly advised to refer to ISO/IEC 15961 and ISO/IEC 15962 for a full exposition of the management issues relating to data strings used for identification data element purposes.

Bodies external to ISO also specify identification data element length and structure for particular applications.

Information technology — Radio frequency identification for item management — Elementary tag licence plate functionality for ISO/IEC 18000 air interface definitions

1 Scope

This Technical Report defines for each of ISO/IEC 18000-2, -3, -4, -6 and -7, and, where relevant, for each Mode within each part, a transaction that achieves an elementary tag "identification data element" for item identification and management.

The transaction uses the existing air interface protocols defined in the corresponding parts of ISO/IEC 18000 or a subset thereof.

2 Normative references

ISO/IEC 18000-2, *Information technology — Radio frequency identification for item management — Part 2: Parameters for air interface communications below 135 kHz*

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 18000-4, *Information technology — Radio frequency identification for item management — Part 4: Parameters for air interface communications at 2,45 GHz*

ISO/IEC 18000-6, *Information technology — Radio frequency identification for item management — Part 6: Parameters for air interface communications at 860 MHz to 960 MHz*

ISO/IEC 18000-7, *Information technology — Radio frequency identification for item management — Part 7: Parameters for active air interface communications at 433 MHz*

ISO/IEC 19762 (all parts), *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762, the relevant part of ISO/IEC 18000, and the following apply.

3.1
elementary tag
RFID tag whose sole functionality is to provide an identification data element

NOTE Further data may be provided, however shall be avoided or be small in order to support the elementary tag concept.

3.2
identification data element
unique data element that may also be used as a location pointer to a database

NOTE Sometimes known as a “licence plate”.

4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviations given in ISO/IEC 19762, the relevant part of ISO/IEC 18000, and the following apply.

ET elementary tag

5 Requirements for elementary tag

This document provides a means to implement an elementary tag (ET) according to the protocol contained in ISO/IEC 18000-2, -3, -4, -6 and -7. It describes a tag which provides only an identification data element. The elementary tag provides complete upward compatibility with full-featured tags according to the relevant part of ISO/IEC 18000.

6 Functionality

6.1 System architecture for ET operation

The overall architecture for an ET system is simple and shown in Figure 1. The operation attributes are shown in Figure 2.

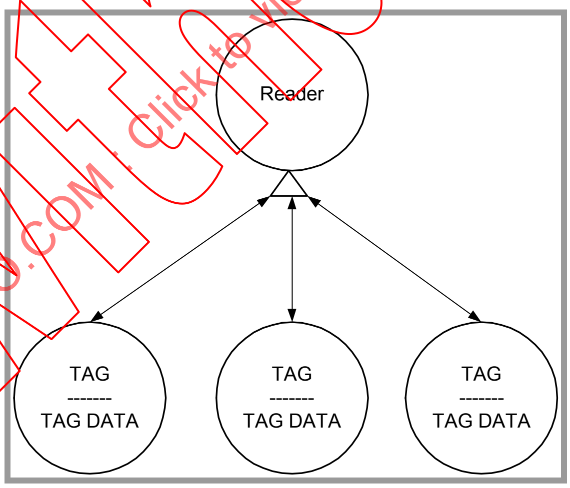

Figure 1 — Object class view of an ET system

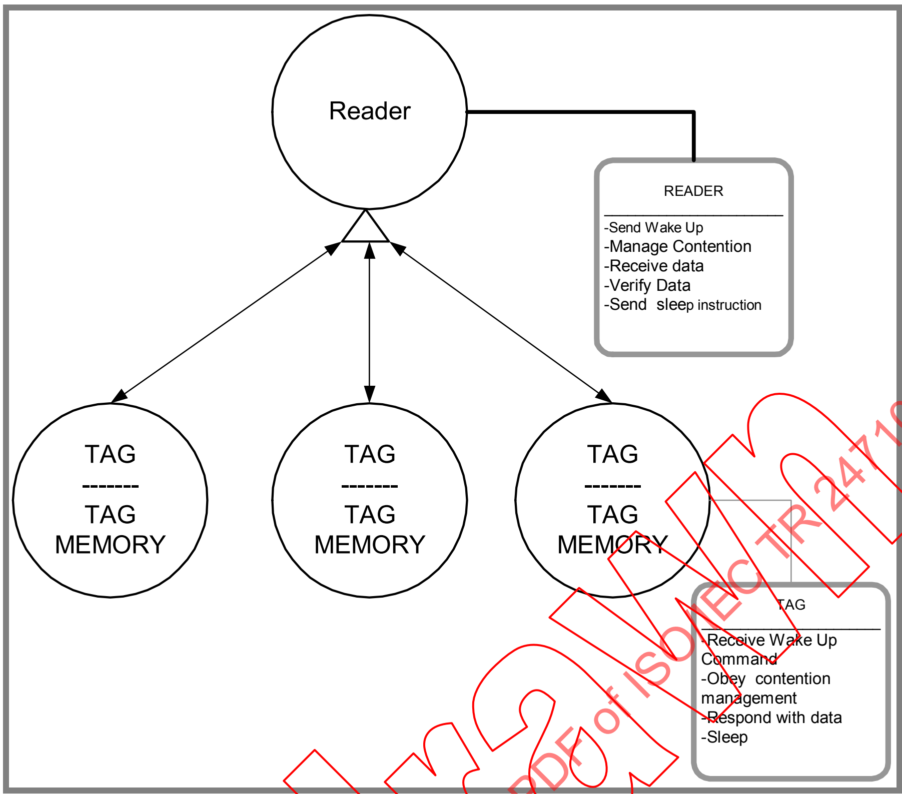

Figure 2 — Object class view of an ET system with attributes

6.2 A summary of ET system capability

6.2.1 Typically an ET conformant tag has a minimum memory of 64 bits. The application will determine the actual user memory size.

6.2.2 An ET interrogator interrogates any ET tags that come into its read zone which are compliant to the relevant ISO/IEC 18000 air interface.

6.2.3 Where more than one ET tag is within the reading zone of an interrogator, the interrogator manages the population of tags within the zone by the use of anti-collision methods described in the relevant part of ISO/IEC 18000. The interrogator shall be able to manage mixed ET/non-ET tag populations.

6.2.4 On receipt of the appropriate ET command(s) from an ET interrogator, the tag responds with its data content according to the relevant annex of this Technical Report.

6.2.5 After the interrogator has obtained the data from the tag, the tag shall be put into a general non-responsive state for a period of time, in order that the interrogator can transact with other tags in the interrogator zone.

6.2.6 A tag with extended functionality, but used in an ET application, retains a specified part of its memory for ET operation, and responds according to the relevant annex of this Technical Report.

6.3 Other capabilities

6.3.1 ET functionality does not support functions such as selective memory addressing, appending data, or rewriting data. Such functionality is supported within the general architecture of ISO/IEC 18000.

6.3.2 An ET conformant tag may be "Write Once/Read Many" (WORM) technology, it may be read/write, or it may be factory pre-programmed. The means of getting data into the ET tag are not the subject of this Technical Report.

6.3.3 Although not part of the ET system operation, an ET interrogator may have other capabilities (such as the ability to write to the tag memory).

6.4 Specific implementations

Annexes A through H detail the specific implementations based on the air interfaces specified in ISO/IEC 18000.

Annex A
(informative)

Elementary tag using ISO/IEC 18000-2 (<135 kHz)

A.1 Introduction

A need for simple tags (also called “elementary tags”) has been expressed for certain item ID applications. The basic functionality required for the tag is a unique 'identification data element' i.e. a binary code on a small number of bits, e.g., 64, 96 or 128 bits.

This annex describes how ISO/IEC 18000-2 can support identification data element functionality independently of its logical structure. This complies with the OSI model that separates the transport layers (in this case the air interface) from the application data representation.

This annex does not define the structure and length of the 'identification data element'. The annex assumes that a standard registration process ensuring uniqueness/unambiguity will manage the data content of such identification data elements, but does not define such process.

A.2 Physical layer and protocol

ISO/IEC 18000-2 specifies two types A and B, which differ only in their physical layer. This allows the physical layer implementation to be as simple as possible.

An individual tag may support only one type. The choice between Type A and B is a matter of several criteria that are outside of the scope of this document.

The protocol is the same for both types and consists of a set of commands.

A.3 Mandatory commands

To claim compliance with ISO/IEC 18000-2, only three commands need to be implemented (in addition to the full implementation of the physical layer A or B):

- The Inventory command (code '00')
- The Read UID command (code '01')
- The Stay quiet command (code '02')

Implementation of these three commands permits an inventory to be made of all tags present in the field of the interrogator - including tags with higher functionality - without any impact on the performance of the inventory function.

The information returned to the interrogator - and therefore to the application - is the tag UID. The format of the tag UID is specified in ISO/IEC 18000-2.

The AFI and the DSFID may be factory programmed or left '00'.

- If the AFI is hard-coded to '00', the tag will participate in any inventory process.
- If the DSFID is hard-coded to '00', its meaning is according to its definition in ISO/IEC 15961, i.e. not formatted and no directory.

A.4 Application-defined code

If the application requires the tag to store and return an application-defined code which differs from the tag UID, this can be achieved in the following ways.

A.4.1 Read single block command

ISO/IEC 18000-2 specifies a block size of 32 bits.

EXAMPLE 1: The application-defined code is 64 bits.

Two (2) Read Single block commands are necessary to read 64 bits**.**

EXAMPLE 2: The application-defined code is 96 bits.

Three (3) Read Single block commands are necessary to read 96 bits.

A.4.2 Read multiple blocks command

An alternative is to use the Read multiple blocks command.

EXAMPLE 1: The application-defined code is 64 bits.

A Read multiple blocks 0 to 1 will return the application-defined code.

EXAMPLE 2: The application-defined code is 96 bits.

A Read multiple blocks 0 to 2 will return the application-defined code.

A.5 New commands and functions

The structure of the command codes allows for the addition of new command codes, e.g. a command that would inhibit permanently the tag. Such command(s) would selectively address the target tag by specifying the tag UID.

A.6 Programmability at the point of issue

The application may require that the application-defined code be programmed at the point of issue of the tag, rather than in the IC manufacture.

A.7 Data content

The data content is not defined in this annex. The annex assumes that data content will be managed by a standard/registration process that will ensure uniqueness and unambiguity.

The ability to support different schema length allows the ISO/IEC 18000-2 ET structure to be consistent with item numbering schemes in global use.

A.8 Conclusion

ISO/IEC 18000-2 allows the design of simple (elementary) tags while keeping interoperability with more sophisticated (R/W) tags and compliance with the standard.

Annex B
(informative)

Elementary tag using ISO/IEC 18000-3 (13,56 MHz) Mode 1

B.1 Introduction

A need for simple tags (also called “elementary tags”) has been expressed for certain item ID applications. The basic functionality required for the tag is a unique 'identification data element' i.e. a binary code on a small number of bits 64, 96 or 128 bits.

The annex describes how ISO/IEC 18000-3 Mode 1 can support identification data element functionality independently of its logical structure. This complies with the OSI I that separates the transport layers (in this case the air interface) from the application data representation.

This annex does not define the structure and length of the 'identification data element'. The annex assumes that a standard registration process ensuring uniqueness/unambiguity will manage the data content of such identification data elements, but does not define such process.

B.2 Mandatory commands

To claim compliance with ISO/IEC 18000-3 Mode 1, only two commands need to be implemented (in addition to the full implementation of the physical layer):

- The 'Inventory' command (code '01')
- The 'Stay quiet' command (code '02')

The only implementation of these two commands allows achieving the inventory of all tags present in the field of the interrogator, including tags with higher functionality, without any impact on the performance of the inventory function.

The information returned to the interrogator and therefore to the application is the tag UID. The format of the UID is specified in ISO/IEC 18000-3 Mode 1 and is on 64 bits.

The AFI and the DSFID may be factory programmed or left '00'.

If the AFI is hard-coded to '00', the tag will participate to any inventory process.

If the DSFID is hard-coded to '00', its meaning is according to its definition in ISO/IEC 15961, i.e. not formatted and no directory.

B.2.1 Application-defined code

If the application requires the tag to store and to return an application-defined code different from the tag UID, this can be achieved in different ways.

B.2.1.1 Read single block command

ISO/IEC 18000-3 allows specifying the block size in number of bytes.

The following example shows how to read an application code of, say, 128 bits.

EXAMPLE 1: Block size is four bytes or 32 bits.

To read an application-defined code, three (4) Read Single block commands are necessary to read 128 bits.

The following example shows how to read an application code of, say, 96 bits.

EXAMPLE 2: Block size is 12 bytes or 96 bits.

To read an application-defined code, one (1) Read single block command is necessary to read 96 bits.

Nota Bene: The size of a block is an element of the air interface, not of the tag physical memory implementation. The physical tag memory can be for instance organized in blocks of 32 bits while the air interface block size is 96 bits. This would likely be the preferred implementation to optimise both the tag architecture and the system performance.

B.2.1.2 Read multiple blocks command

An alternative is to use the 'Read multiple blocks' command.

EXAMPLE 1: Block size is 4 bytes or 32 bits. The application-defined code is on 64 bits.

A 'Read multiple blocks 0 to 1' will return the application-defined code.

EXAMPLE 2: Block size is 4 bytes or 32 bits. The application-defined code is on 96 bits.

A 'Read multiple blocks 0 to 2' will return the application-defined code.

NOTE: From an implementation point of view, both solutions should be similar in terms of IC complexity. If different application-defined code sizes are possible, the 'Read single block' approach with a block size equal to the application-defined code is preferred.

B.2.1.3 New commands and functions

The structure of the command codes allows for the addition of new command codes, e.g. a command that would inhibit permanently the tag. Such command(s) would selectively address the target tag by specifying the tag UID.

B.3 Programmability at the point of issue

The application may require that the application-defined code be programmed at the point of issue of the tag rather than in the IC manufacture. This is achieved by the 'Write block' command. The impact on the complexity of the IC only depends on the memory technology (for instance EEPROM will require a charge-pump) and is independent of the protocol. ISO/IEC 18000-3 Mode 1 makes no provision or restriction on such memory technology.

B.4 Data content

The data content is not defined in this annex. The annex assumes that data content will be managed by a standard/registration process that will ensure uniqueness and unambiguity.

The ability to support different schema length allows the ISO/IEC 18000-3 Mode 1 ET structure to be consistent with item numbering schemes in global use.

B.5 Conclusion

ISO/IEC 18000-3 Mode 1 allows the design of simple (elementary) tags while keeping interoperability with more sophisticated (read/write) tags and compliance with the standard.

Annex C
(informative)

Elementary tag using ISO/IEC 18000-3 (13,56 MHz) Mode 2

C.1 Introduction

A need for simple tags (also called "elementary tags") has been expressed for certain item ID applications. The basic functionality required for the tag is a unique 'identification data element' i.e. a binary code on a small number of bits 64, 96 or 128 bits.

This annex describes how ISO/IEC 18000-3 Mode 2 can support identification data element functionality independently of its logical structure. This complies with the OSI model that separates the transport layers (in this case the air interface) from the application data representation.

This annex does not define the structure and length of the 'identification data element'. The annex assumes that a standard registration process ensuring uniqueness/unambiguity will manage the data content of such identification data elements, but does not define such process.

C.2 Physical layer

The physical layer is to behave as determined in ISO/IEC 18000-3 Mode 2.

C.3 Mandatory commands

The single mandatory command required to support ET functionality in the field is the READ command as defined in ISO/IEC 18000-3 Mode 2. This annex explains how to enact such simple 'identification data element' reads.

The one single 'Read' command is used to wake up the tag, instruct it to return the data (of length defined in the read command) and to shut down the tag after the data has been read.

C.4 ET tag identification

C.4.1 To identify an ET tag, interrogators will repetitively transmit a simple read command as defined in ISO/IEC 18000-3 Mode 2.

C.4.2 When a tag enters the read zone it will reply to the command. The reply will include the identification data element number. Therefore identification and read of tag memory contents is executed with a single interrogator read command and a single tag reply.

C.4.3 Table C.1 shows the read length and address details required to read various identification data element lengths.

Table C.1 — Read length and address details for ISO/IEC 18000-3 Mode 2 'identification data element'

Identification data element length	Read address	Read length	Comment
e.g. 64 bits	word 10	4 words	4 word read from word 10
96 bits	word 10	6 words	6 word read from word 10
128 bits	word 10	8 words	8 word read from word 10
n bits	word 10	(n bits)/16 words	X word read from word 10

C.4.4 The identification data element is stored at word 10 and upward. The read command must be set to extract the identification data element.

C.4.5 After a tag has been identified and read the interrogator can transmit a read command that identifies the individual tag and temporarily mutes it. This command and others targeted at different tags will effectively reduce the tag population and thus improve the identification rate of the remaining tags. Once a tag has been temporarily muted this way it will not reply to normal read commands issued by the interrogator that muted the tag. A temporarily muted tag will return to normal operation after it has been powered down for a short period.

C.5 Read command data

All read commands are 112 bits long (including the flag field). All read commands include a 16 bit flag followed by command, command number, identifier, address and CRC fields. The flag field includes a MFM error. Examples of the hexadecimal data for the command fields following the flag are given in Table C.2.

Table C.2 — HEX data in READ command

Identification data element length	Read command type	Command data
e.g. 64 bits	4 word read (from word 10)	000A FFFF FFFF 0000 040A 9DB7
96 bits	6 word read (from word 10)	000A FFFF FFFF 0000 060A BEA5
128 bits	8 word read (from word 10)	000A FFFF FFFF 0000 080A 57DB

C.6 Reply data

All short replies include a 16-bit flag field followed by timestamp, specific identifier, data and CRC fields. Examples of the hexadecimal data for the reply fields following the flag are given in Table C.3.

Table C.3 — HEX data in REPLY command

Reply type	Reply data	Reply length	Reply time
4 word read reply (64 bit License Plate)	FFFF ABCD 1234 0001 0002 0003 0004 DB1F 7A08	160 bits	1510 µs
6 word read reply (96 bit identification data element)	FFFF ABCD 1234 0001 0002 0003 0004 0005 0006 0049 4803	192 bits	1812 µs
8 word read reply (128 bit identification data element)	FFFF ABCD 1234 0001 0002 0003 0004 0005 0006 0007 0008 39CD EA77	224 bits	2114 µs

In the case where multiple tags are simultaneously present in the interrogator read zone, the interrogator will use the anti-collision protocol described in ISO/IEC 18000-3 Mode 2. The commands used will be the read commands given above (modified for muting ratio to maximise the identification rate). As tags are identified and read they can be temporarily muted by read commands (with a muting ratio set to fully muted). All command lengths are still 112 bits or 264 µs.

C.7 Data content

The data content is not defined in this annex. The annex assumes that data content will be managed by a standard/registration process that will ensure uniqueness and unambiguity.

The ability to support different schema length allows the ISO/IEC 18000-3 Mode 1 ET structure to be consistent with item numbering schemes in global use.

C.8 Initial tag set up for ET

The description in the preceding clauses show how the ET "identification data element" read is achieved using ISO/IEC 18000-3 Mode 2. C.8.1 to C.8.3 describe how to perform the initial Tag programming for ET identification data element.

C.8.1 Programming the License Plate

The identification data element number is programmed and locked at manufacture or in the field. Once the identification data element is locked it cannot be overwritten by an interrogator command. An interrogator command that attempts to write to locked memory is considered to be an invalid command. If an interrogator transmits an invalid command a tag will not respond or transmit a reply.

The identification data element number to be stored in chip memory from word 10 and above (user memory).

C.8.2 Programming at Manufacture

If the identification data element is programmed at manufacture, the memory in the IC can be other than a field programmable type, and the IC does not need not to support interrogator write commands.

C.8.3 Programming in the Field

Interrogator write commands, as defined in ISO/IEC 18000-3 Mode 2, may be used to for field programming of the Licence Plate if programming in the field is permitted by the Schema Manager.

C.9 Conclusion

ISO/IEC 18000-3 Mode 2 can provide ET identification data element functionality within ISO/IEC 18000, and can support variable identification data element lengths. It further allows design of simple (elementary) tags, in compliance with the supported subsets, while keeping interoperability in mixed populations where more sophisticated (R/W) tags are also present.

Annex D
(informative)

Elementary tag using ISO/IEC 18000-4 (2,45 GHz) Mode 1

D.1 Introduction

A need for simple tags (also called “elementary tags”) has been expressed for certain item ID applications. The basic functionality required for the tag is a unique 'identification data element' i.e. a binary code on a small number of bits 64, 96 or 128 bits.

The annex describes how ISO/IEC 18000-4 Mode 1 can support identification data element functionality independently of its logical structure. This complies with the OSI model that separates the transport layers (in this case the air interface) from the application data representation.

This annex does not define the structure and length of the 'identification data element'. The annex assumes that a standard registration process ensuring uniqueness/unambiguity will manage the data content of such identification data elements, but does not define such process.

D.2 Physical layer

The physical layer is as described in ISO/IEC 18000-4 Mode 1.

D.3 Command set

The command set comprises:

- For anti-collision based on tag UID
- Data retrieval of application data for item identification
- Initializing/programming the tag memory

D.4 Command set for anti-collision when user data is not necessarily unique

The data content is not defined in this annex. The annex assumes that data content will be managed by a standard/registration process that will ensure uniqueness and unambiguity.

The ability to support different schema length allows the ISO/IEC 18000-4 Mode 1 ET structure to be consistent with item numbering schemes in global use.

The anti-collision commands described in Table D.1 describe the anti-collision based on the tag UID programmed by the manufacturer.

D.4.1 Command set

Table D.1 — Command codes

Command code	Command name
'08'	FAIL
'09'	SUCCESS
'0A'	INITIALIZE
'15'	RESEND
'17'	GROUP_SELECT_EQ_FLAGS
'18'	GROUP_SELECT_NE_FLAGS

D.4.2 Memory usage

Table D.2 — Memory usage

Byte	Content
0	Tag UID
1	Tag UID
2	Tag UID
3	Tag UID
4	Tag UID
5	Tag UID
6	Tag UID
7	Tag UID
8 –17	RFU – system memory
18 – ...	User data

Although the unique user data start at address ‘12’ (byte 18), it is not necessary to implement the memory elements between “08” and “11”. The actual memory size depends on the memory requirements of the customer, which may be 32 bits, 64 bits or whatever is required.

D.5 Data retrieval

The command noted in Table D.3 provides access to application data for item identification.

Table D.3 — Access to application data

Command code	Command name
'0C'	Read

D.6 Command for memory initialization

Memory initialization may be achieved by the commands for write access specified in ISO/IEC 18000-4 Mode 1, or by any proprietary command.

Further, the write command may be also applied on one time programmable memory.

D.7 Data content

ISO/IEC 18000-4 Mode 1 defines a use of a tag UID (bytes 0 – 7) for anti-collision. As noted, the 'Elementary tag' does not of necessity use this UID to represent data identifying the item to which the “tag” is attached.

The data content is not defined in this annex. The annex assumes that data content will be managed by a standard/registration process that will ensure uniqueness and unambiguity.

The ability to support different schema length allows the ISO/IEC 18000-4 Mode 1 ET structure to be consistent with item numbering schemes in global use.

Application data may be used to distinguish one ET from another as it relates to the “item”. This identification data element “value” must be unique and unambiguous for item identification.

D.8 Conclusion

ISO/IEC 18000-4 Mode 1 provides the use of 'Elementary tag' identification data element functionality within ISO/IEC 18000, and the flexibility for variable identification data element lengths. It further allows design of simple (elementary) Tags, in compliance with the supported subsets, while keeping interoperability in mixed populations where more sophisticated (R/W) tags are also present.

Annex E
(informative)

Elementary tag using ISO/IEC 18000-4 (2,45 GHz) Mode 2

E.1 Introduction

A need for simple tags (also called “elementary tags”) has been expressed for certain item ID applications. The basic functionality required for the tag is a unique 'identification data element' i.e. a binary code on a small number of bits 64, 96 or 128 bits.

The annex describes how ISO/IEC 18000-4 Mode 2 can support 'identification data element' functionality independently of its logical structure. This complies with the OSI model that separates the transport layers (in this case the air interface) from the application data representation.

This annex does not define the structure and length of the 'identification data element'. The annex assumes that a standard registration process ensuring uniqueness/unambiguity will manage the data content of such identification data elements, but does not define such process.

E.2 General description

ISO/IEC 18000-4 Mode 2 is a Tag Talks First system. For 'identification data element' operation no commands and receiver structures in the tag are necessary. Therefore both of the described R/O-tags within ISO/IEC 18000-4 Mode 2 will be appropriate for such applications.

The information returned to the interrogator and therefore to the application is the tag UID. The format of the tag UID is specified in ISO/IEC 18000-4 Mode 2 and is 32 bits in length, but with the possibility of extension. The tag UID is not used for anti-collision.

E.3 Tag UID-Extension

If the application requires the tag to store and return a larger bit sequence than 32 bit tag UID (e.g. 96 bits), then a tag UID extension must be used.

The Memory ID within the MIDx-CH of R/O-tags can be used to extend the total amount of data within the return link.

- Memory ID within MID1 and MID2 can be used to extend the UID with MID3 and MID4 (ID1 equal 1).
- Memory ID within MID3 and MID4 again can be used to extend the UID with MINx-CH (ID1 equal 1). MINx-CH consists of 64bits data.

E.4 Data content

The data content is not defined in this annex. The annex assumes that data content will be managed by a standard/registration process that will ensure uniqueness and unambiguity.

The ability to support different schema length allows the ISO/IEC 18000-4 Mode 2 ET structure to be consistent with item numbering schemes in global use.

E.5 Conclusion

ISO/IEC 18000-4 Mode 2 allows the design of simple (elementary) tags while keeping interoperability with R/O-tags or more sophisticated R/W-tags and compliance with the standard.

Annex F
(informative)

Elementary tag using ISO/IEC 18000-6 (860 MHz to 960 MHz) Type A

F.1 Introduction

A need for simple tags (also called “elementary tags”) has been expressed for certain item ID applications. The basic functionality required for the tag is a unique 'identification data element' i.e. a binary code on a small number of bits 64, 96 or 128 bits.

The annex describes how ISO/IEC 18000-6 Type A can support identification data element functionality independently of its logical structure. This complies with the OSI model that separates the transport layers (in this case the air interface) from the application data representation.

This annex does not define the structure and length of the 'identification data element'. The annex assumes that a standard registration process ensuring uniqueness/unambiguity will manage the data content of such identification data elements, but does not define such process.

For example purposes only, the annex describes an elementary tag offering 96 bits of user data in the form of an Identity.

F.2 Elements of the Protocol

The protocol is implemented according to ISO/IEC 18000-6 Type A. The communications protocol is a sub-set of the ISO protocol using only three of the commands as defined in ISO/IEC 18000-6. All other commands may be ignored.

F.3 Commands

Init_round command code = '01'

The 'Init_round' command has two functions:

- It instructs tags that are not in the 'Quiet' state to enter a new round, to reset their slot counters to 1 and to enter the 'Round_active' state. Tags in the 'Quiet' state to remain in this state.
- It instructs tags that are in the 'Round_active' state to use the specified round size.

Next_slot command code = '02'

The 'Next_slot' command has two functions:

- It acknowledges the tag, which has been identified.
- It instructs all tags in the 'Round_active' state to switch to the next slot by incrementing their slot counter.

There is no tag response to the 'Next_slot' command. It may either enter the 'Quiet' state or switch to the next slot by incrementing its slot counter.

Reset_to_ready (Asynchronous) Command code = '06'

The 'Reset_to_ready' command has one function:

- It instructs all tags to enter the ready state.

F.4 Tag Response

The response from the tag consists of the following fields:

- Preamble
- Flags – 2 bits (ET tags always set to '0')
- Parameter field comprising
- Signature – 4 bits
- Tag type – 1 bit
- Battery Status – 1bit
- Random number – 6 bits. (Either random or derived from data and/or CRC fields).
- Data – 96 bits
- CRC – 16 bits (according to Annex A of ISO/IEC 18000-6:2004).

Table F.1 — Response Format

Preamble	Flags	Signature	Type	Battery Status	Random Number	Data	CRC
	2 bits	4 bits	1 bit	1 bit	6 bits	96 bits	16 bits

F.5 Tag states

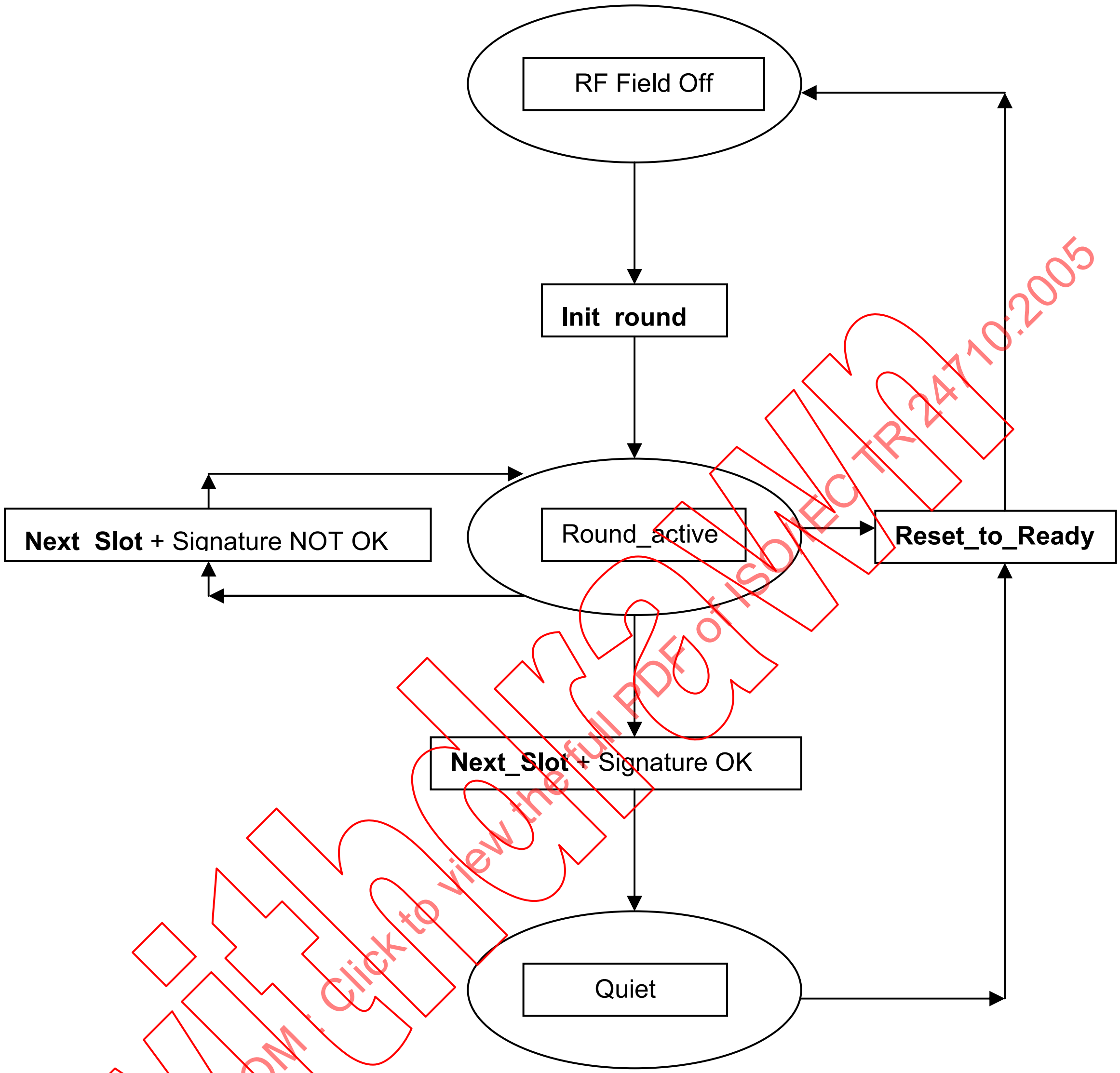

Figure F.1 — State Diagram

F.6 Collision arbitration

Tag collision arbitration uses the method described in ISO/IEC 18000-6 Type A.

F.7 Data structure

F.7.1 General

An 'Elementary tag' does not of necessity contain a tag UID. The only means of distinguishing one ET from another is the identification data element value, which must be unique and unambiguous. A proposed scheme is shown in Table F.2 — Data format.

Table F.2 — Data format

Header	Prefix	Type	Serial Number
8 bits	24 bits	24 bits	40 bits

The total number of bits shown in Table F.2 is 96. The data partitions are flexible, as described below.

F.7.2 Header

This field allows determination of varying field formats for the remainder of the code space, thereby allowing for structured distinction between different versions of ET over time. A single, neutral body, with global coverage, must administer the value of this field.

F.7.3 Prefix

This field identifies the “owner” of the ET code. A single, neutral body with global coverage must administer the value of this field.

F.7.4 Type

This field may be used to differentiate between types of items with which ETs are associated.

F.7.5 Serial number

This field allows ETs with the same value of header, prefix and type to be distinguished one from another.

This proposed structure is consistent with item numbering schemes in global use.

F.8 Data content

The data content is not defined in this annex. The annex assumes that data content will be managed by a standard/registration process that will ensure uniqueness and unambiguity.

The ability to support different schema length allows the ISO/IEC 18000-6 Type A ET structure to be consistent with item numbering schemes in global use.

F.9 Conclusion

ISO/IEC 18000-6 Type A allows the design of simple (elementary) tags while keeping interoperability with R/O-tags or more sophisticated R/W-tags and compliance with the standard.

Annex G
(informative)

Elementary tag using ISO/IEC 18000-6 (860 MHz to 960 MHz) Type B

G.1 Introduction

A need for simple tags (also called “elementary tags”) has been expressed for certain item ID applications. The basic functionality required for the tag is a unique 'identification data element' i.e. a binary code on a small number of bits 64, 96 or 128 bits.

The annex describes how ISO/IEC 18000-6 Type B can support identification data element functionality independently of its logical structure. This complies with the OSI model that separates the transport layers (in this case the air interface) from the application data representation.

This annex does not define the structure and length of the 'identification data element'. The annex assumes that a standard registration process ensuring uniqueness/unambiguity will manage the data content of such identification data elements, but does not define such process.

For example purposes only, the annex describes an elementary tag offering 96 bits of user data in the form of an identity.

The 'Elementary tag' provides complete upward compatibility with feature re-writable tags according to the standard.

G.2 Physical layer

The physical layer is as described in Clauses 6 and 8.1 of ISO/IEC 18000-6:2004 Type B.

G.3 Command set

The command set may be divided into 3 parts:

- Anti-collision based on tag UID where user data cannot be assumed to be unique
- Anti-collision using unique user data
- Initializing/programming of tag memory

Depending on the application and intended use, only one of the command groups may be implemented.

G.4 Command set for anti-collision where user data is not necessarily unique

The anti-collision commands described in Table G.1 describe the anti-collision based on the tag UID programmed by the manufacturer. In this case the tag may include any user data.

G.4.1 Command set

Table G.1 — Command set

Command code	Command name
'08'	FAIL
'09'	SUCCESS
'0A'	INITIALIZE
'15'	RESEND
'17'	GROUP_SELECT_EQ_FLAGS
'18'	GROUP_SELECT_NE_FLAGS

G.4.2 Memory usage

Table G.2 — Memory usage

Byte	Content	Remark
0	Tag UID	
1	Tag UID	
2	Tag UID	
3	Tag UID	
4	Tag UID	
5	Tag UID	
6	Tag UID	
7	Tag UID	
8 –17	RFU – system memory	Physical implementation depending whether functionality should be supported
18 - …	User data	

G.5 Command set for anti-collision with unique data programmed by the user

The anti-collision commands described in Table G.3 describe the anti-collision process based on the unique user data.

G.5.1 Command set

Table G.3 — Command set with unique data programmed by user

Command code	Command name
'17'	GROUP_SELECT_EQ_FLAGS
'18'	GROUP_SELECT_NE_FLAGS
‘40’, ‘41’	FAIL_O
‘42’, ‘43’	SUCCESS_O
‘44’, ‘45’	DATA_READ_O
‘46’, ‘47’	RESEND_O

