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Information technology — Radio frequency identification (RFID) for item management — Data protocol: data encoding rules and logical memory functions

Technologies de l'information — Identification par radiofréquence (RFID) pour la gestion d'objets — Protocole de données: règles d'encodage des données et fonctions logiques de mémoire

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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.

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 document 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 or www.iec.ch/members_experts/refdocs).

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. 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) or the IEC list of patent declarations received (see patents.iec.ch).

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. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

This third edition cancels and replaces the second edition (ISO/IEC 15962:2013), which has been technically revised.

The main changes are as follows:

— editorial changes were made;

— references have been updated.

A list of all parts in the ISO/IEC 15962 series can be found on the ISO and IEC websites.

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 and www.iec.ch/national-committees.

Introduction

The technology of radio frequency identification (RFID) is based on non-contact electronic communication across an air interface. The structure of the bits stored on the memory of the RFID tag is invisible and accessible between the RFID tag and the interrogator only by the use of an air interface protocol, as specified in the appropriate part of the ISO/IEC 18000 series. The result of the transfer of data between an application and an interrogator in open systems requires data to be encoded in a consistent manner on any RFID tag that is part of that open system. This is not only to allow equipment to be interoperable, but in the special case of data carriers, for the data to be encoded on the RFID tag in one system's implementation for it to be read at a later time in a completely different and unknown system's implementation. The data bits stored on each RFID tag must be formatted in such a way as to be reliably read at the point of use if the RFID tag is to fulfil its basic objective. This reliability is achieved through the specification of a Data Protocol using the application-defined arguments defined in ISO/IEC 15961-1 and the data encoding rules of this document. Additionally, ISO/IEC 24791-1 specifies a software system infrastructure architecture that enables RFID system operations between business applications and RFID interrogators. Specific parts of the ISO/IEC 24791 series address data management requirements (ISO/IEC 24791-2) and device interface requirements (ISO/IEC 24791-5). These support defined implementations that incorporate the encoding rules of this document and the functional rules of the commands and responses in ISO/IEC 15961-1.

Manufacturers of RFID equipment (e.g. interrogators, RFID tags) and the users of RFID technology require a standards-based Data Protocol for RFID for item management. ISO/IEC 15961-1, ISO/IEC 15961-2, ISO/IEC 15961-3, this document and the ISO/IEC 24791 series specify this protocol, which is layered above the air interface standards defined in the ISO/IEC 18000 series.

The Data Protocol used to exchange information in an RFID system for item management is specified in ISO/IEC 15961-1 and in this document. Both documents are required for a complete understanding of the Data Protocol in its entirety, but each focuses on one particular interface:

— ISO/IEC 15961-1 addresses the interface with the application system.

— This document deals with the processing of data and its presentation to the RF tag, and the initial processing of data captured from the RF tag.

The transfer of data to and from an application, supported by appropriate application commands, is the subject of ISO/IEC 15961-1. This document specifies the overall process and the methodologies developed to format the application data into a structure to store on the RFID tag.

Information technology — Radio frequency identification (RFID) for item management — Data protocol: data encoding rules and logical memory functions

1 Scope

This document focuses on encoding the transfer syntax of the application commands defined in ISO/IEC 15961-1. The encodation is in a Logical Memory as a software analogue of the physical memory of the RFID tag being addressed by the interrogator.

This document

— defines the encoded structure of object identifiers;

— specifies the data compaction rules that apply to the encoded data;

— specifies a Precursor for encoding syntax features efficiently;

— specifies formatting rules for the data, e.g. depending on whether a directory is used or not;

— defines how application commands, e.g. to lock data, are transferred to the Tag Driver;

— specifies processes associated with sensory information and the transfers to the Tag Driver;

— defines other communication to the application.

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 19762, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

3 Terms and definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762 and the following apply. ISO and IEC maintain terminology databases for use in standardization at the following addresses:

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

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

3.1.1
data compaction
mechanism, or algorithm, to process the original data so that it is represented efficiently in fewer bytes in a data carrier than in the original presentation

3.1.2
data processor
implementation of the processes defined in this document, including the Data Compactor, Formatter, Logical Memory, and Command/Response Unit

3.1.3
precursor
byte, sometimes a sequence of bytes, used in the Directory and No-Directory Access-Methods that acts as metadata for the subsequent Object-Identifier and Object

3.2 Abbreviated terms

FQIDV	Fully-qualified ID value
IDLPO	ID List Packed Object
IDMPO	ID Map Packed Object
PO	Packed Object
TBD	To be determined
TEI	Text element identifier
URN	uniform resource name

Since "TDS", "Type A" to "Type D" are commonly used in the industry to refer to the technology components as specified by these standards, the following designations are used in this document:

Type A	refers to ISO/IEC 18000-61
Type B	refers to ISO/IEC 18000-62
Type C	refers to ISO/IEC 18000-63
Type D	refers to ISO/IEC 18000-64
TDS	refers to GS1 EPC, *Tag Data Standard*

4 Conformance

4.1 Conformance with the air interface

A conformant implementation of this document shall support one or more air interface protocols through the Tag Drivers defined in Annex C. Declarations of conformance shall refer to the specific air interface protocol(s). This applies to encoders, decoders, or more comprehensive devices.

4.2 Conformance with the application interface

4.2.1 Encoders and the application interface

Within the constraints of the air interface protocol supported, a conformant implementation of this document on an encoder shall support the application commands defined in 8.2 and the associated process argument, as defined in Clause 10.

A conformant RFID tag shall have its encoding in a state that can be properly decoded by a conformant decoder (see 4.2.2).

4.2.2 Decoders and the application interface

Within the constraints of the air interface protocol supported, a conformant implementation of this document on a decoder shall support the application commands defined in 8.3 and the associated process argument, as defined in Clause 10.

4.2.3 Comprehensive encoder/decoder devices and the application interface

Within the constraints of the air interface protocol supported, a conformant implementation of this document on an encoder/decoder shall support the application commands defined in 8.2 and 8.3 and the associated process argument, as defined in Clause 10. In addition, the Delete-Object (see 8.4.2) and Modify-Object (see 8.4.3) commands shall be supported. Other commands defined in 8.4 may be supported, and each command that is supported shall be declared.

4.3 Conformance with the Access-Method

4.3.1 Encoders and the Access-Method

A conformant implementation of this document on an encoder shall support the encoding rules and formatting rules of one or more Access-Methods as defined in Clause 11 and associated Annexes. Declarations of conformance shall refer to the specific Access-Method(s) supported.

4.3.2 Decoders and the Access-Method

A conformant implementation of this document on a decoder shall support the decoding rules and formatting rules of all the Access-Methods as defined in Clause 11 and associated Annexes.

An interrogator is not expected to fully support the decoding functions of all the Access-Methods, and the following shall apply to achieve conformance:

— For full conformance, the decoder process on the interrogator shall output the Object-Identifier, Object and other arguments as required in the responses to the commands.

— For partial conformance, the decoder process on the interrogator shall output the byte string that represents the encoded package (depending on the Access-Method) containing the requested Object-Identifier. The encoded package then shall be fully decoded by a decoder process, external to the interrogator that is fully in conformity with the rules defined in this document.

Declarations of conformance shall refer to the specific Access-Method(s) supported.

4.3.3 Comprehensive encoder/decoder devices and the Access-Method

A conformant implementation of this document on an encoder/decoder shall support the encoding rules and formatting rules of one or more Access-Methods as defined in Clause 11 and associated Annexes. Declarations of conformance shall refer to the specific Access-Method(s) supported. The decoding function shall be as defined in 4.3.2.

5 Protocol model

5.1 Overview

RFID supports bit encodation in the RFID tag memory. Unlike other data carrier standards which require encodation schemes that are specific to the individual data carrier technology, the ISO/IEC 18000 series does not specify the interpretation of bits or bytes encoded on the RFID tag memory. However, as an RFID tag is a relay in a communication system, each tag used for open systems item management shall have data encoded in a consistent manner. The prime function of ISO/IEC 15961-1 is to specify a common interface between the application programs and the RFID interrogator. The prime function of this document is to specify the common encoding rules and Logical Memory functions.

RFID tags utilise electronic memory, which is typically capable of increasing data capacity as new generations of product are introduced. Differences in data capacity of each RFID tag type, whether similar or dissimilar, are recognised by the Data Protocol defined in these two documents.

Different application standards may have their own datasets or data dictionaries. Each major application standard for item management shall have its data treated in an unambiguous manner, avoiding confusion with data from other applications and even with data from closed systems. The Data Protocol specified in these documents ensures the unambiguous identification of data.

5.2 Layered protocol

5.2.1 Layers

The protocol layers of an implementation of RFID for item management are illustrated schematically in Figure 1.

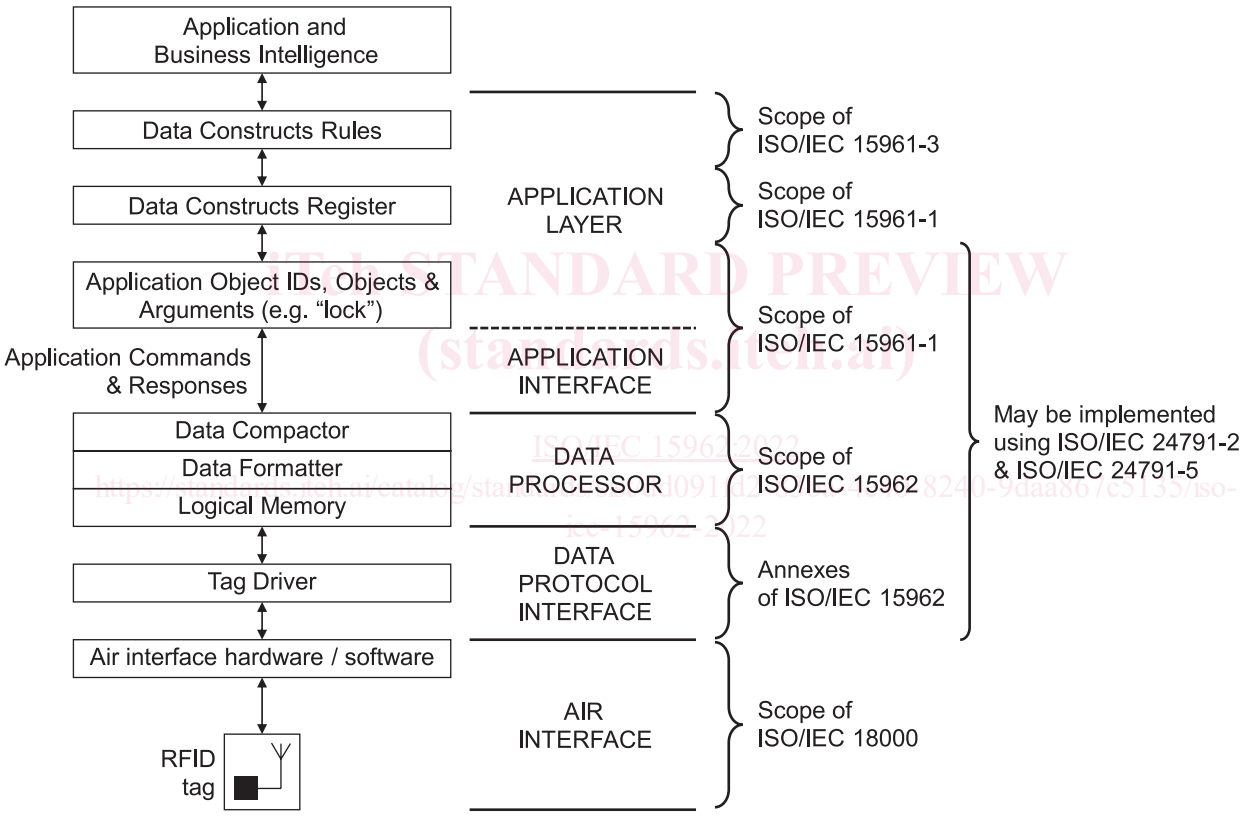

Figure 1 — Schematic of protocol layers for an implementation of RFID for item management

5.2.2 Application layer as defined in the ISO/IEC 15961 series

The RFID Data Protocol specifies how data is presented as objects, each uniquely identified with an object identifier, which are meaningful to the application and can be encoded on the RFID tag. ISO/IEC 15961-3 specifies the data construct rules for the AFI, DSFID, object identifier for the unique item identifier, and object identifier structure for other item-related data. This ensures that each piece of data can be uniquely identified, both within the scope of a particular application and between applications.

Each application shall be registered according to ISO/IEC 15961-2 so that the data constructs can be declared and used in an unambiguous manner.

The RFID Data Protocol in ISO/IEC 15961-1 defines functions and arguments used to construct application commands and responses. This is so that application programs can specify what data to

transfer to and from the RFID tag and to append, update, selectively lock, delete data, or perform other functions on the RFID tag.

NOTE To illustrate how the functions and arguments are assembled into a structured format, several commands and responses have been constructed using an abstract syntax. This is independent of the host application, operating system, and programming language and independent of the specific command structures between the interrogator and Tag Driver. The abstract syntax used in ISO/IEC 15961-1 is like that used in ISO/IEC 24791-5, and is intended to enable closer integration with that standard. The original version of ISO/IEC 15961:2004[1)] included commands defined using ASN.1 abstract syntax, see ISO/IEC 8825-1. For backward compatibility, the commands that were originally defined in this manner have been included in an annex of ISO/IEC 15961-1.

This RFID Data Protocol also defines arguments and codes to support responses of data that is read from an RFID tag, including error messages, which are returned to the application.

The abstract syntax may be used as a basis to prepare commands in different programme languages, supporting the functionality and arguments of the abstract commands.

5.2.3 Application interface as defined in ISO/IEC 15961-1

The application interface may be implemented in several different ways that are not explicitly defined in this document, nor in ISO/IEC 15961-1. The basic requirement is to identify data objects distinctly from all others using object identifiers, even to enable different data formats to be intermixed on the same RFID tag. The application interface also shall define command and response arguments unambiguously, so that they can be intermixed with data on the same wired or wireless network.

One major class of implementation, described as a *straight-through process*, is appropriate where the functions and arguments used to construct commands and the arguments and codes used to construct responses, as specified in this document, are directly input to the encoding processes of ISO/IEC 15962. Such input can be from computer screens or forms, or more direct transfers from host systems. The advantage of this process is that it avoids the creation of the transfer encoding (see below) but requires more rigorous adherence to the functional requirements of the commands and responses. ISO/IEC 15961-1 imposes no constraints on the application interface process to be adopted, other than the requirement that it be integrated with the encoding rules of ISO/IEC 15962.

Whichever approach is used, the encoding rules of ISO/IEC 15962 shall be followed, and the encoding on the RFID tag shall be in conformity with all the arguments in the commands specified in ISO/IEC 15961-1.

5.2.4 Data Protocol processing

The RFID Data Protocol specifies how data is encoded, compacted, and formatted on the RFID tag and how this data is retrieved from the RFID tag to be meaningful to the application.

This RFID Data Protocol provides for a set of schemes that compact the data to make more efficient use of the memory space.

This RFID Data Protocol also supports various storage formats to enable efficient use of memory and efficient access procedures.

5.2.5 Data Protocol interface

Each air interface protocol standard in the ISO/IEC 18000 series has its own specific rules for defining commands and responses. Furthermore, some air interface protocols can support different tag architectures with different memory sizes, and possibly support optional commands. The Data Protocol provides a mechanism to interface with these rules through specific Tag Drivers. These allow the basic application commands and responses of ISO/IEC 15961-1 to be applied independently of the air interface protocol and specific tag architecture.

1) Withdrawn standard. Revised by ISO/IEC 15961-1:2013, ISO/IEC 15961-2:2019, ISO/IEC 15961-3:2019, ISO/IEC 15961-4:2016.