Information technology — Radio frequency identification (RFID) for item management: Data protocol —

Part 4:
Application interface commands for battery assist and sensor functionality

Techniques automatiques d'identification et de capture des données —

Partie 4:

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Contents

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.

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

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

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.

ISO/IEC 15961-4 was prepared by Technical Committee ISO/TC JTC1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

ISO/IEC 15961 consists of the following parts, under the general title *Information technology — Radio frequency identification (RFID) for item management*:

⎯ *Part 1: Application interface*

⎯ *Part 2: Registration of RFID data constructs*

⎯ *Part 3 Data constructs*

⎯ *Part 4: Application interface commands for battery assist and sensor functionality*

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 in the memory of the RFID tag is invisible and accessible between the RFID tag and the interrogator only by the use of the appropriate air interface protocol, as specified in the corresponding part of ISO/IEC 18000. Since the initial publication of ISO/IEC 18000, it has become possible to add sensors to the RFID tag using various physical methods, but always using the air interface protocol as a consistent means of communicating between the RFID tag and the interrogator.

For sensor information, functional commands from the application and responses from the interrogator are processed in a standard way. This allows equipment to be interoperable. In the special case of the sensor attached to or integrated within an RFID tag, enables configuration parameters to be encoded in one system's implementation with the resultant sensory information to be read at a later time in a completely different and unknown system's implementation. The data bits stored on each RFID tag and sensor must be formatted in such a way as to be reliably read at the point of use if the sensor is to fulfil its basic objective. The integrity of this is achieved through the use of an application protocol, for example as supported by the functional commands specified in this part of this International Standard and as specified in ISO/IEC 24791.

Manufacturers of radio frequency identification equipment (interrogators, RFID tags, etc.), manufacturers of sensors, and users of RFID technology supporting sensors each require a publicly available application protocol. This International Standard specifies the sensor encoding and processing rules, which are independent of any of the air interface standards defined in the various parts of ISO/IEC 18000. As such, the sensor encoding and processing rules are consistent components in the RFID system that may, independently, evolve to support additional air interface protocols and different types of sensors.

The international standards that comprise the data protocol are:

— ISO/IEC 15961-1 defines the transfer of data to and from the application, supported by appropriate application commands and responses.

— ISO/IEC 15961-2 defines the registration procedure of data constructs to ensure that as new applications adopt the data protocol that it becomes a relatively straightforward process to support that application. This can be achieved by the Registration Authority publishing regular updates of the RFID data constructs that have been assigned, and for a means of incorporating these updates into the processes of ISO/IEC 15961-1.

— ISO/IEC 15961-3 defines the data constructs and the rules that govern their use.

— ISO/IEC 15961-4 defines the transfer of sensor data to and from the application, supported by appropriate application commands and responses.

— ISO/IEC 15962 specifies the overall process and the methodologies developed to format the application data into a structure to store on the RFID tag.

— ISO/IEC 24753 specifies the overall process and methodologies developed to format and process sensory information in a standardised manner and provide an interface with the appropriate air interface protocol.

Information technology — Radio frequency identification (RFID) for item management — Part 4: Application interface commands for battery assist and sensor functionality

1 Scope

This part of ISO/IEC 15961 provides a set of application commands and their associated responses for the following functions:

— To start and stop battery assistance

— To select and de-select a particular sensory function supported by the RFID tag

— To set sensor parameters both initially and ongoing

— To start and stop the sensor monitoring the environment

— To access sensor data

— To establish the battery status

ISO/IEC 24753 defines the encoding rules for identifying sensors, their functions, their delivered measurements, and the processing rules for sensor data. As such, it receives commands as defined in this International Standard and provides the information that is required for the appropriate responses.

2 Normative references

The following referenced documents are indispensable for the application 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 18000-63, *Information technology -- Radio frequency identification for item management -- Part 63: Parameters for air interface communications at 860 MHz to 960 MHz Type C*

ISO/IEC 18000-64, *Information technology -- Radio frequency identification for item management -- Part 64: Parameters for air interface communications at 860 MHz to 960 MHz Type D*

ISO/IEC 19762-1, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 1: General terms relating to AIDC*

ISO/IEC 19762-3, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 3: Radio frequency identification (RFID)*

ISO/IEC/IEEE 21451-7[1], *Information technology — Smart transducer interface for sensors and actuators — Part 7: Transducers to radio frequency identification (RFID) systems communication protocols and transducer electronic data sheet (TEDS) formats*

ISO/IEC 24753, *Information technology — Radio frequency identification (RFID) for item management — Application protocol: encoding and processing rules for sensors and batteries*

3 Terms, definitions, and abbreviated terms

For the purposes of this document, the terms, definitions, and abbreviations given in ISO/IEC 19762, ISO/IEC/IEEE 21451-7, ISO/IEC 24753 and the following apply.

3.1
sensor processor
implementation of the processes specified in ISO/IEC 24753 to convert between data and information relevant to the application layer and the bit based encoding on the sensor memory

4 Conformance

4.1 General

The commands and responses in this part of ISO/IEC 15961 are only expressed in an abstract syntax. Their structure is determined by the records and fields on the particular sensor. As such, conformance to this part of ISO/IEC 15961 for a particular sensor system is specifically indicated by the resultant proper encoding according to ISO/IEC 24753 and then passed through RFID air interface protocols to the sensor.

The arguments and fields contained in individual commands and responses identify what needs to be taken into account for correct input to the ISO/IEC 24753 Sensor Processor to achieve a valid encoding. Also, they identify what an application expects to have returned following access to a sensor on an RFID tag. Because of the way the protocol is structured, the commands and responses specified in this part of ISO/IEC 15961 are, to a large extent, independent of particular RFID tag types that support sensors. The effect of this is that ISO/IEC 24753 can specify conformance requirements for valid encoding, which this part of ISO/IEC 15961 cannot.

All the commands and arguments, and their associated processes, are specified in detail in ISO/IEC 24753. Object Identifiers are used throughout that standard to uniquely identify arguments within commands and responses for each type of sensor. Object Identifiers are also used to identify fields with particular sensor records.

4.2 Conformance of the Sensor Processor

The Sensor Processor is, effectively, the implementation of ISO/IEC 24753. An implementation of ISO/IEC 24753 is required to support one or both of the following:

a) All the processes that are required to support all aspects of full function sensors for configuration and interpretation of sensor data.

b) All the processes that are required to support all aspects of simple sensors for configuration and interpretation of sensor data.

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1) As IEEE 1451.7 was published in June 2010, and is the reference used in ISO/IEC 24753, this is the reference used in the body of the text in this part of ISO/IEC 15961

4.3 Application conformance

An application is expected to support the commands and responses that are defined in ISO/IEC 24753 for full function sensors and/or simple sensors. Therefore this part of ISO/IEC 15961 shall support either one or both options (a) and (b) (see 4.2) as determined by the implementation of ISO/IEC 24753 with which it interfaces.

In addition, the application conformance requirements defined by the commands and responses in this part of ISO/IEC 15961 may be simplified to address a specific type of simple or full function sensor, even to the extent of only the records and commands required for that sensor. For the commands that are supported, all the arguments in the command and response shall be supported to achieve the interface with the sensor processor.

5 Logical interface model

5.1 General

The processes defined in this part of ISO/IEC 15961 are implemented between the application and the air interface protocol. This part of ISO/IEC 15961 performs similar functions for sensory data as ISO/IEC 15961-1 does for item-related data. The relationship and basic functions of the standards are illustrated in Figure 1.
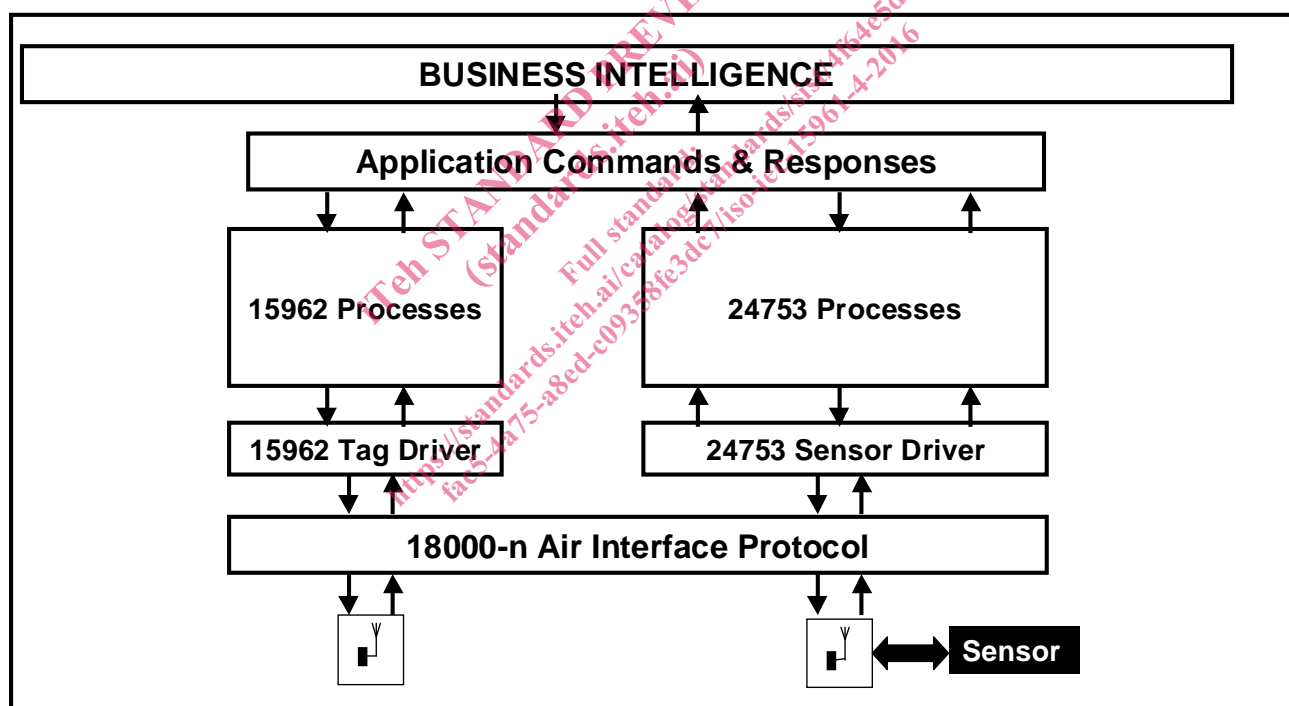

Figure 1 — Basic application interface model

ISO/IEC 24753 is essential reading in implementing this part of ISO/IEC 15961. Reference needs to be made to that standard for a full description of the component parts of the model relevant to sensors and batteries. An overview relevant to this part of ISO/IEC 15961 is provided below.

5.2 Application commands

A set of functional application commands is required to enable the application to identify what sensor functions are supported, to access data from sensors, to access the status of the battery power, and to reset values such as alarm values for the sensor activity. These are defined in Clause 6 for simple sensors and Clause 7 for full function sensors.

The structure of the application commands and response can be determined by clauses in ISO/IEC 24753 that use the same name. The structure of these commands may be derived from the set of object identifiers applicable for each command and response as specified in ISO/IEC 24753. Because of this, only selected application interface commands are fully described in this part of ISO/IEC 15961.

5.3 The sensor information model for full function sensors

The sensor information model for full function sensors (Figure 2) shows the relationship between component processes and structures described later in ISO/IEC 24753 for full function sensors specified in IEEE 1451.7. A physical sensor is defined as one that monitors a particular environmental feature capable of being expressed in terms of an SI unit or derived SI unit. A given physical sensor may support a number of logical sensors, each of which specifies a method of event data output, e.g. maximum value, observed value below a threshold qualified by a timestamp, count of events observed that are above a threshold.
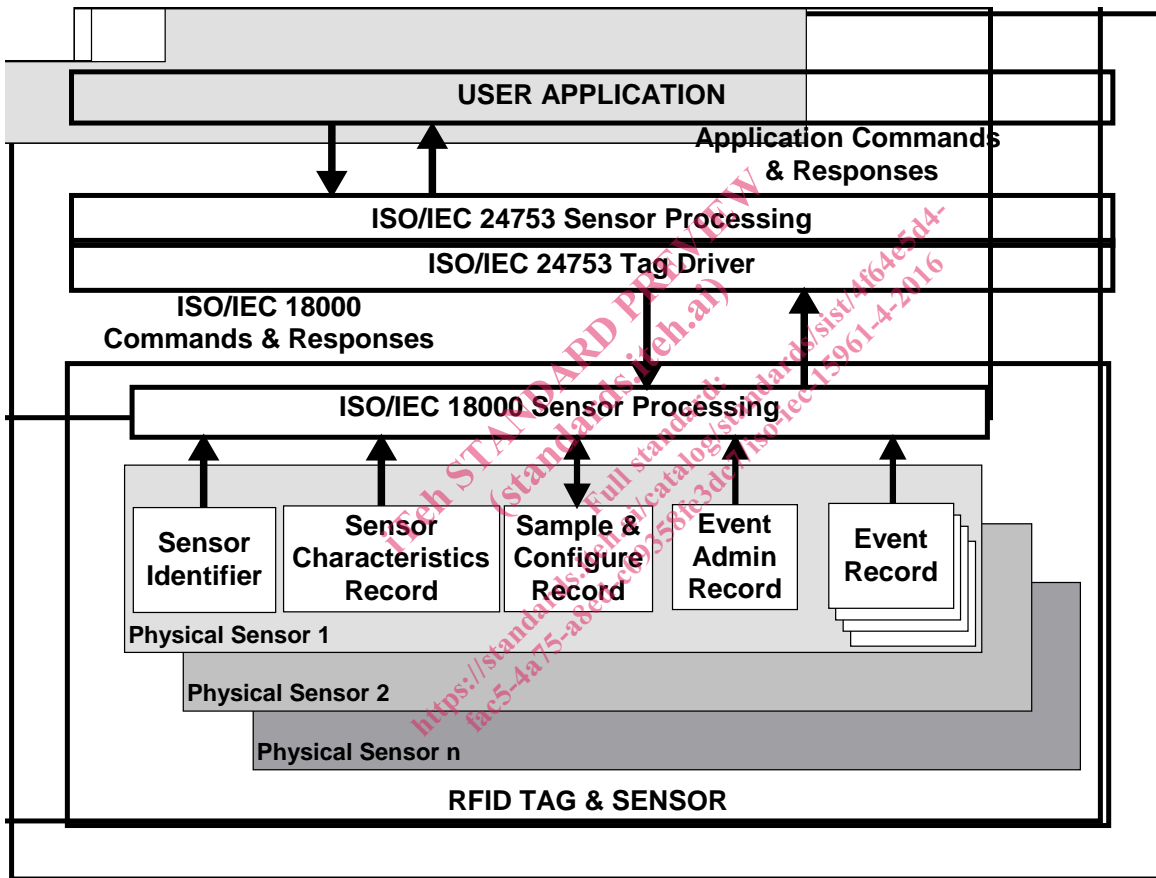

Figure 2 — Sensor information model for full function sensors

Figure 2 clearly illustrates that the commands and responses defined in this part of ISO/IEC 15961 need to be able to communicate with the Sensor Processor, which is the implementation of ISO/IEC 24753. In turn, the specific arguments within the commands and responses need to comply with the requirements of the five sensor records:

— Record 1: Sensor identifier

— Record 2: Sensor characteristics record

— Record 3: Sample and configuration record

— Record 4: Event admin record

— Record 5: Event record

The commands are described in Clause 6.

5.4 The sensor information model for simple sensors

A simple sensor provides limited functional support to determine whether the temperature or other environmental conditions have gone outside some allowable limits. These sensors are defined as factory programmed, which restricts parameter setting from a fully open systems application, but allows data to be captured using open system air interface commands and processes.

The prime operating mode of a simple sensor is to provide the simple sensor data block using some delivery mechanism defined by the air protocol interface. The simple sensor data block is a short bit-based code that provides sensor characteristics, configuration and alarm data. Currently this is 32 bits long, but provision exists for a maximum length of 48-bits.

There are two formats of simple sensor. The memory mapped simple sensor supports only the simple sensor data block, which is on the same integrated circuit platform as the data on the RFID tag. The ported simple sensor supports additional mandatory and optional records, as detailed in the list (below). An annex of ISO/IEC 18000-63 defines the requirements for processing these records if present on the ported simple sensor.

NOTE   ISO/IEC 18000-64 does not support ported simple sensors.

The sequence of records is as follows:

— Record 1: Simple sensor data block (mandatory for both implementations)

— Record 2: Manufacturer record (mandatory only for the ported simple sensor)

— Record 3: Authorisation password record (optional for the ported simple sensor)

— Record 4: Calibration record (recommended for the ported simple sensor)

— Record 5: Sample and configuration record (mandatory only for the ported simple sensor)

— Record 6: Event record (recommended for the ported simple sensor)

— Record 7: Time synchronisation record (mandatory only for the ported simple sensor and only if the event record is present)

6 Simple sensor commands

6.1 Current air interface reference

The processing of commands (and responses) for simple sensors is specified in ISO/IEC 24753, which uses Object Identifiers to identify the specific arguments. As such it is possible in this part of ISO/IEC 15961 to specify the structure of commands and responses in a manner that does not depend on the existence of a particular type of simple sensor. There can only be 16 different types of simple sensor, and the sensor manufacturer permanently encodes a 3-bit binary value into a predefined location in the sensor memory to identify the sensor type. In turn, the type code is included as a specific arc in the Object Identifier.

Simple sensors as specified in ISO/IEC 18000-63 and ISO/IEC 18000-64 are used throughout this part of ISO/IEC 15961 to described arguments and processes. Later versions of these air interface protocols need to be checked for type codes not addressed here (see the current list in 6.3.1.1). If the basic design for simple sensors is maintained in the air interface protocol and in ISO/IEC 24753, then this part of ISO/IEC 15961 can