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Information technology — Guidelines for using data structures in AIDC media

Technologies de l'information — Directives pour l'usage des structures de données dans des medias d'AIDC

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Foreword

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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, 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), it may decide to publish a Technical Report. A Technical Report is entirely informative in nature and shall be subject to review every five years in the same manner as an International Standard.

Attention is drawn to the possibility that some of the elements of this Technical Report 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 29162 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

Introduction

Radio frequency identification (RFID) is one of the AIDC media widely used in the market place. Linear bar codes and two-dimensional symbols have long utilized AIDC media. The international standard for AIDC syntax is ISO/IEC 15434. ISO/IEC 15961 and ISO/IEC 15962 were developed as encoding rules for RFID.

Users have long utilized linear bar codes and two-dimensional symbols for item identification and numerous RFID technologies have recently been developed. Users who want to utilize RFID transponders should consider compatibility with linear bar codes and two-dimensional symbols already in the system. Because of the growing diversity and complexity of AIDC media in the market place, especially in RFID, it is not easy for users to understand how to read and write their data to each application of AIDC media.

This Technical Report explains common data structures used in both optically readable media (linear bar codes and two-dimensional symbols) and radio-frequency identification. It primarily addresses the use of ASC MH10 Data Identifiers to provide the semantics, ISO/IEC 15434 to provide the syntax, and ISO techniques of unique item identification with ISO/IEC 15961 Application Family Identifiers (AFIs) and encoding rules for RFID using ISO/IEC 15962.

Those interested in applications using Air Transport Association (ATA) SPEC 2000, Text Element Identifiers, are encouraged to contact the ATA for specific guidance.

Those interested in applications using GS1 Application Identifiers and EPC, specifically for material found in the EPC Tag Data Standard (TDS), are encouraged to contact GS1 for specific guidance.

Information technology — Guidelines for using data structures in AIDC media

1 Scope

This Technical Report provides guidance on the use of AIDC media (e.g. linear bar codes, two-dimensional symbols, RFID transponders) in the supply chain.

2 Normative references

The following referenced documents are indispensable for the application of this Technical Report. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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 (all parts) apply.

4 Abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO/IEC 19762 (all parts) and the following apply.

AFI	Application Family Identifier
AI	Application Identification
AIDC	Automatic Identification and Data Capture
CIN	Company Identification Number
DI	Data Identifier
DSFID	Data Storage Format Identifier
ECI	Extended Channel Interpretations
EPC	Electronic Product Code
IAC	Issuing Agency Code
IATA	International Air Transport Association

IEP Inter-sector Electronic Purse

ISBT International Association of Blood Transfusion services

OID Object Identifier

PC Protocol Control (bits)

RFID Radio Frequency Identification

SN Serial Number

TEI Text Element Identifier

TID Tag identification

UII Unique Item Identifier

UML Unified Modeling Language

UPU Universal Postal Union

VIN Vehicle Identification Number

XPC Extended PC (bits)

5 Standards applied to data encoding for AIDC media

AIDC media in various forms are transported and/or stored, together with goods or items.

ISO/IEC 15434 was developed as a syntax for high capacity AIDC media and applied to many kinds of two-dimensional symbols.

ISO/IEC 15961 and ISO/IEC 15962 were developed for RFID air interface standards, as an encoding method only for RFID.

For the sake of simplicity, users want to use a single data standard for the various forms of AIDC media. (See Figure 1). However, because of the inherent characteristics of RFID and optical technologies, differences in data encoding arise, some of which will be described within this Technical Report.

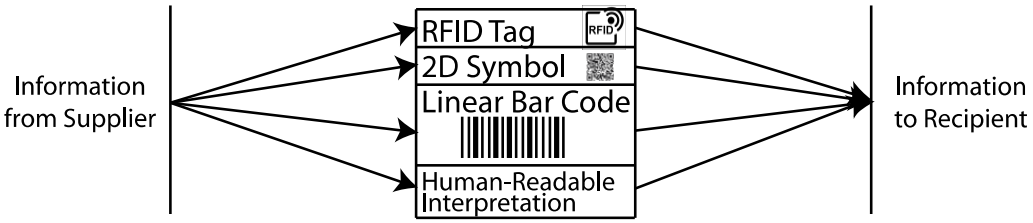

Figure 1 — Application user requirement

For example, bar codes are always scanned one at a time, but a large population of RFID tags can be inventoried nearly simultaneously. To support the RFID inventory operation, the Unique Item Identificaiton (UII) of the RFID tag is prefaced by “filtering” information (a numbering system identifier or an AFI) that has no correlation in bar code systems.

As a second example, for faster inventory operations, many RFID tag architectures transmit only the UII portion of their data during inventory, sending item attendant data only upon request. In contrast, a 2D symbol reader always obtains and transmits the full contents simultaneously (both UII and item attendant data).

Since the 1970s, linear bar code symbols have typically encoded application-specific “license plate” item information. The bar code symbol encodes an identifying primary key to a database entry that contains current information about the item. If the bar code identifier is not serialized (UPC symbols are an example), it identifies a class of item, such as a certain product of a certain size. If serialized, the “license plate” identifies a specific instance of an item; in open system applications, it is important that the identification system can guarantee that each “license plate” is uniquely distinct from all others.

Unique Item Identifiers (UIIs) can be contained in “unique identification-only” media such as a license-plate bar code symbol or an RFID tag containing only a UII. In the case of “unique identification-only,” a database or look-up to trading partner communications is required to establish additional information about the entity to which the UII is attached. Technologies such as two-dimensional symbols and data rich RF tags can contain this additional “item attendant data” within that medium.

A number of ISO/IEC specifications have been developed for encoding and decoding of linear bar code symbologies, such as ISO/IEC 15420 for EAN/UPC and ISO/IEC 15417 for Code 128, and for two-dimensional symbologies, such as ISO/IEC 15438 for PDF417 (see Bibliography for a complete list).

The remainder of this technical report describes currently available methods for encoding both UII and item attendant data in optical and RFID media. For all two-dimensional symbols, the data syntax specified in ISO/IEC 15434 (and summarized in Section 6 of this Technical Report) can be used. For most RFID data carriers, the UII is encoded separately (for efficient inventory operations), and the item attendant data should be encoded using ISO/IEC 15434 syntax. The RFID encoding options are summarized in Sections 7, 8, and 9 of this Technical Report, and additional RFID-specific guidance is provided in Sections 10, 11, and the Annexes A through D

6 ISO/IEC 15434 application for high capacity AIDC media

ISO/IEC 15434 is a transfer structure, syntax and coding of messages and data formats when using high capacity AIDC media between trading partners, specifically between suppliers and recipients and, where applicable, in support of carrier applications such as bills of lading and carrier sorting and tracking;

ISO/IEC 15434 includes encoded data:

- used in the shipping, receiving and inventory of transport units;
- contained within supporting documentation, in paper or electronic form, related to unit loads or transport packages;
- used in the sorting and tracking of transport units;
- used for the sorting and tracking of returnable transport items;
- used for the sorting and tracking of products and product packages.

To allow multiple data formats to be contained within a data stream, a two level structure of enveloping is employed. The outermost layer of the message is a Message Envelope that defines the beginning and end of the message. Within the Message Envelope are one or more Format Envelopes that contain the data (See Figure 2). Multiple formats in a single message should be employed only through trading partner agreements.

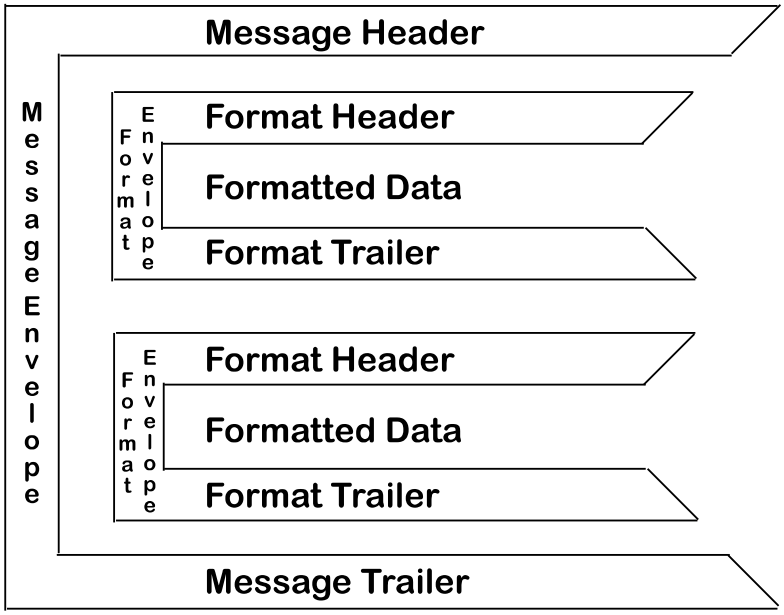

Figure 2 — Envelope structure of ISO/IEC 15434

6.1 Assigned formats in ISO/IEC 15434

Header data and format trailer for each format are defined in Table 1.

Table 1 — ISO/IEC 15434 header data and trailers

Format Indicator	Variable Header Data	Format Trailer	Format Description
00			Reserved for future use
01	$^{G}_{S}vv$	$^{R}_{S}$	Transportation
02			Complete EDI message / transaction
03	$vvvrrr^{F}_{S}{}^{G}_{S}{}^{U}_{S}$	$^{R}_{S}$	Structured data using ANSI ASC X12 Segments
04	$vvvrrr^{F}_{S}{}^{G}_{S}{}^{U}_{S}$	$^{R}_{S}$	Structured data using UN/EDIFACT Segments
05	$^{G}_{S}$	$^{R}_{S}$	Data using GS1 Application Identifiers
06	$^{G}_{S}$	$^{R}_{S}$	Data using ASC MH 10 Data Identifiers
07		$^{R}_{S}$	Free form text
08	*vvvvrrnn*		Structured data using CII Syntax Rules
09	$^{G}_{S}$ *ttt...t* $^{G}_{S}$ *ccc...c* $^{G}_{S}$ *nnn...n* $^{G}_{S}$	$^{R}_{S}$	Binary data (file type) (compression technique) (number of bytes)
10-11			Reserved for future use
12	$^{G}_{S}$	$^{R}_{S}$	Structured data following Text Element Identifier rules
13-99			Reserved for future use

Users should refer to ISO/IEC 15434 for the use of information objects as defined in the EDI standard directories, GS1 AI directory *(GS1 General Specification)* or ANSI DI directory *(ANS MH10.8.2)*.

6.2 System data elements for compatibility across all AIDC media

As bar code technology began to proliferate in the 1980s, it became apparent that the need existed to encode more than simple product identity. Lot/batch and serial numbers, purchase order numbers, destination postal codes, country of origin and a unique license plate for the entity might all need to be encoded on a single label. Schemes in various industries evolved until the cross-industry exchange of product forced standardization of tags, or prefixes, to identify the information encoded in the bar code. This gave rise to the standardization of Data Identifiers (DIs) and Application Identifiers (AIs), referred to as the semantics of an AIDC data structure, managed by ASC MH10 (DIs) and GS1 (AIs) as defined in ISO/IEC 15418.

Over time, applications were developed for encoding the information on a shipping label into a single symbol, permitting the information to be read with a single scan. The ability to encode multiple data fields into a symbol created the requirement to know whether DIs or AIs were being read, where the various structures ended and others began, and when one would know that no more data followed. This gave rise to the standardization of data structures into messages, referred to as the syntax of an AIDC message, and was codified in ANS MH10.8.3 and later in ISO/IEC 15434.

ISO/IEC 24729-1, *Information technology — Radio frequency identification for item management — Part 1: RFID-enabled labels* provides a method for enoding the information resident in the RF tag into an optical symbol, thereby ensuring a backup source of data if the RFID tag should fail.

6.3 Data Carrier Identifiers for RFID and other AIDC media

Various applications need to identify the type of data carrier, and readers and interrogators are able to identify the means by which the data was entered: RFID, bar code, or key entry. They are able to preface the data with a data carrier identifier, following the rules of ISO/IEC 15424, *Information technology -- Automatic identification and data capture techniques -- Data Carrier Identifiers (including Symbology Identifiers).*

As an example, if an RF tag is unreadable, it may be possible to access a “back-up” technology, e.g. a linear bar code or two-dimensional symbol. If there is no “back-up” symbol or if it is unreadable, it may be necessary to key enter the data. Studies for key-entry of data have shown an error rate of approximately 1 in every 300 characters entered, compared to automated techniques with an error rate of 1 in every 1 000 000 characters entered, or better. If an RF tag or optically readable media fails, it is important to notify the supplier.

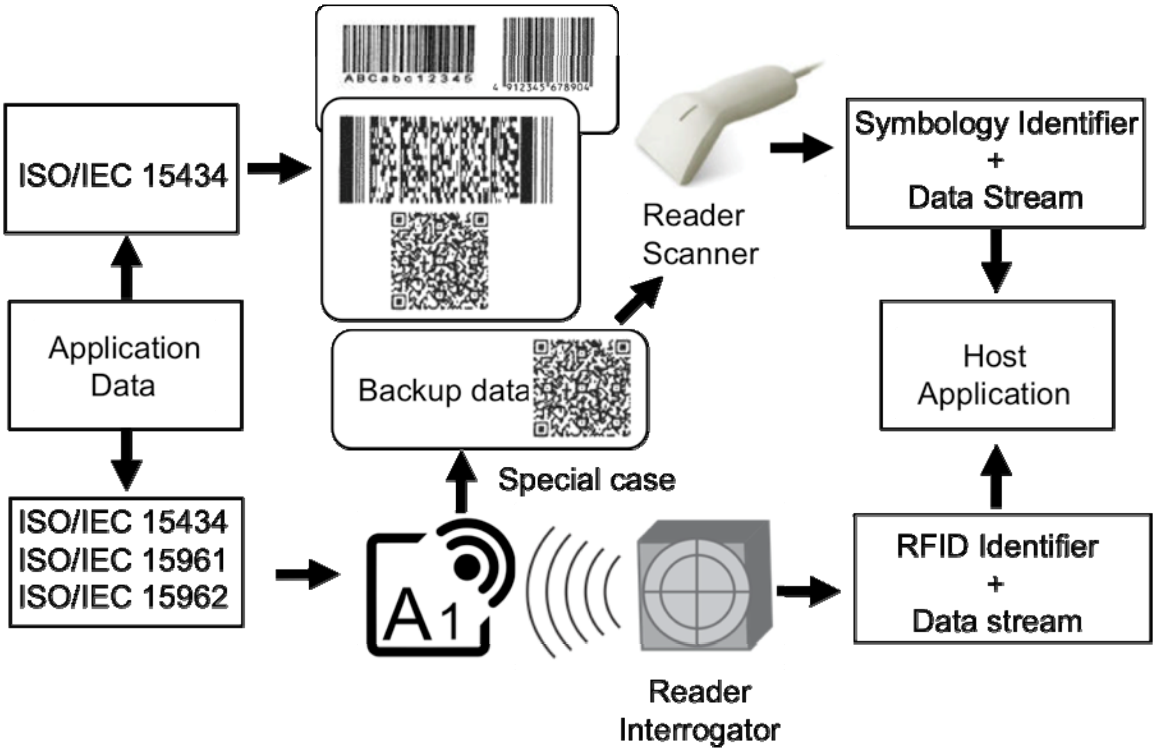

Figure 3 — Operation of data carrier identifiers

7 RFID encoding of UII

Figure 5 shows the memory layout of ISO/IEC 18000-63, Type C and ISO/IEC 18000-3, Mode 3 ASK RF tags. UIIs are encoded in Memory Bank ‘01’ ($MB01_2$), as shown in Figure 6. The ISO/IEC 15459 series deals specifically with Unique Item Identifiers (UIIs), including the means to identify physical objects according to ISO TC 122’s 1736x relevant documents, and EPC.

The AFI (Application Family Identifier) is encoded in $MB01_2$ in the event trading partners do not use EPC structures. The following subsections detail the steps involved.

7.1 Extant numbering systems for RFID

There are several existing systems to uniquely identify physical objects in an RFID context. These include:

- ISO/IEC 15459-1:2006, *Information technology — Unique identifiers — Part 1: Unique identifiers for transport units*
- ISO/IEC 15459-2:2006, *Information technology — Unique identifiers — Part 2: Registration procedures*
- ISO/IEC 15459-3:2006, *Information technology — Unique identifiers — Part 3: Common rules for unique identifiers*
- ISO/IEC 15459-4:2006, *Information technology — Unique identifiers — Part 4: Unique identifiers for individual items*
- ISO/IEC 15459-5:2007, *Information technology — Unique identifiers — Part 5: Unique identifier for returnable transport items (RTIs)*
- ISO/IEC 15459-6:2007, *Information technology — Unique identifiers — Part 6: Unique identifier for product groupings*
- ISO/IEC 15963:2004, *Information technology — Radio frequency identification for item management — Unique identification for RF tags*

- ISO/IEC 7816-5:2004, *Identification cards — Integrated circuit cards — Part 5: Registration of application providers,*
- ISO/IEC 7816-6:2004, *Identification cards — Integrated circuit cards — Part 6: Inter-industry data elements for interchange*
- *EPCglobal Tag Data Standards, Version 1.5*
- ITU X.668 | ISO/IEC 9834-9, *Information technology – Open Systems Interconnection – Procedures for the operation of OSI Registration Authorities: Registration of object identifier arcs for applications and services using tag-based identification*
- ITU X.660, *Information technology – Open Systems Interconnection – Procedures for the operation of OSI Registration Authorities: General procedures and top arcs of the International Object Identifier tree*

7.2 Tag type and UII data storage area

In the early RF tags, RFID memory consisted of a conventional memory structure, incorporating a system area and a user memory area, as shown in Figure 4. However, in ISO/IEC 18000-63 type C RFID, the structure changed, and the memory structure and the kinds of data that could be written in each memory area are defined in the ISO/IEC 18000-63 standard.

From the standpoint of storing UII data, the early RFID had only one user memory area and that is where UII data was stored. It is recommended that UII data should be the first element in these user area data elements.

In 18000-63 RFID, UII data is written in the UII are. If users intend to deal with two or more UIIs for one item, the second UII is considered as user data. Because the UII data writing area is dependent on both the memory type and the intention of the user, the system user should pay careful attention to this point.

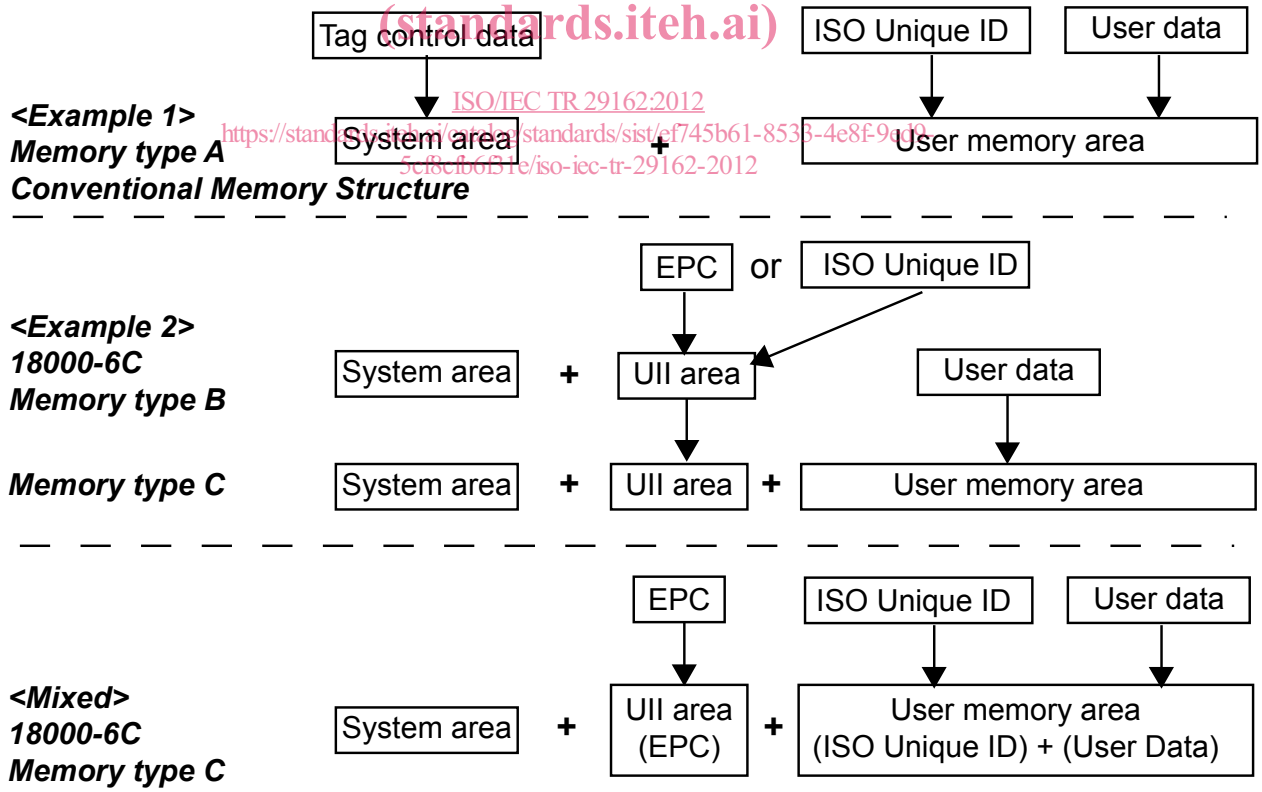

Figure 4 — RFID memory type and stored data to each memory area