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Automatic identification and data capture techniques — Supply chain applications of RFID — Product tagging, product packaging, transport units, returnable transport units and returnable packaging items

Techniques automatiques d'identification et de capture des données — Applications de chaîne d'approvisionnements de RFID — Étiquetage de produits, empaquetage de produits, unités de transport, éléments restituables de transport et éléments d'empaquetage restituables

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Contents

Page

Foreword

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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).

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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 first edition of ISO/IEC 17360 cancels and replaces ISO 17367:2013, ISO 17366:2013, ISO 17365:2013 and ISO 17364:2013, which has been technically and editorially revised.

The main changes are as follows:

— ISO 17367:2013, ISO 17366:2013, ISO 17365:2013 and ISO 17364:2013 have been integrated into this document;

— 8-bit encoding and decoding using the UTF-8 encoding set has been added;

— binary encoding of the UII has been added;

— outdated processes and information have been updated.

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 Supply Chain is a multi-level concept that covers all aspects of taking a product from raw materials to a final product, including shipping to a final place of sale, use and maintenance and, potentially, disposal. Each of these levels covers many aspects of dealing with products and the business process for each level is both unique and overlaps other levels.

For the purposes of this document, “product”, “product packaging”, “transport unit”, and “returnable transport item (RTI) and returnable packaging item (RPI)” are all called items.

For the purposes of this document, the value of a single byte is represented using hexadecimal characters written as 0xnn, where “0x” is the hexadecimal indicator and “nn” is the hexadecimal value.

For the purposes of this document, a series of 1’s and/or 0’s followed by a subscript 2 indicates that these series of digits are to be interpreted as bit values, or as a number expressed in binary form.

For the purposes of this document, the representation of the tags memory banks (MB) 00_2, $MB01_2$, $MB10_2$ and $MB11_2$ are represented as MB00, MB01, MB10 and MB11.

Automatic identification and data capture techniques — Supply chain applications of RFID — Product tagging, product packaging, transport units, returnable transport units and returnable packaging items

1 Scope

This document defines the basic features of RFID for use in the supply chain when applied to product tagging, product packaging, transport units and returnable transport items (RTIs) and returnable packaging items (RPIs). This document:

— provides specifications for the identification of the items,

— makes recommendations about additional information on the RF tag,

— specifies the semantics and data syntax to be used,

— specifies the data protocol to be used to interface with business applications and the RFID system,

— specifies the minimum performance requirements,

— specifies the air interface standards between the RF interrogator and RF tag, and

— specifies the reuse and recyclability of the RF tag.

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 445, *Pallets for materials handling — Vocabulary*

ISO/IEC 15418, *Information technology — Automatic identification and data capture techniques — GS1 Application Identifiers and ASC MH10 Data Identifiers and maintenance*

ISO/IEC 15434, *Information technology — Automatic identification and data capture techniques — Syntax for high-capacity ADC media*

ISO/IEC 15459-2, *Information technology — Automatic identification and data capture techniques — Unique identification — Part 2: Registration procedures*

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

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 18000-63, *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 19762, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

ISO/IEC 20248, *Information technology — Automatic identification and data capture techniques — Digital signature data structure schema*

ISO/IEC 29160, *Information technology — Radio frequency identification for item management — RFID Emblem*

ANSI MH10.8.2, *Data Identifiers*

GS1 *EPC Tag Data Standard (TDS)*

GS1 *General Specifications.*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 445, 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
domain authority identifier
DAID
unique identifier of an entity fulfilling the role of a Domain Authority who is the issuer of the data contain in the tag

3.2
packaging
material used for the containment, protection, handling, delivery, storage, transport and presentation of goods

Note 1 to entry: Ownership changes at time of purchase or delivery.

3.3
returnable packaging item
RPI
material used for the "protection" of goods during handling, delivery, storage and transport that are returned for further usage

Note 1 to entry: See Annex E for details on the use of returnable *packaging* (3.2) items.

Note 2 to entry: Ownership does not change at time of purchase or delivery.

4 Concepts

Figures 1 and 2 give a graphical representation of supply chain layers. They show a conceptual model of possible supply chain relationships – not a one-for-one representation of physical things. Although several layers in Figure 2 have clear physical counterparts, some common supply chain physical items fit in several layers depending on the use case. For example, as shown in Figure 2, a repetitively used pallet under constant ownership will be covered as a returnable transport item (RTI), a pallet that is part of a consolidated unit load will be covered as a transport unit and a pallet that is integral to a single item will be covered as product packaging. See Annex E for additional details on RTIs.

The term "supply chain layers" or levels, is a multi-level concept that covers all aspects of taking a product from raw materials to:

— a final product;

— shipping;

— a final place of sale, use, maintenance;

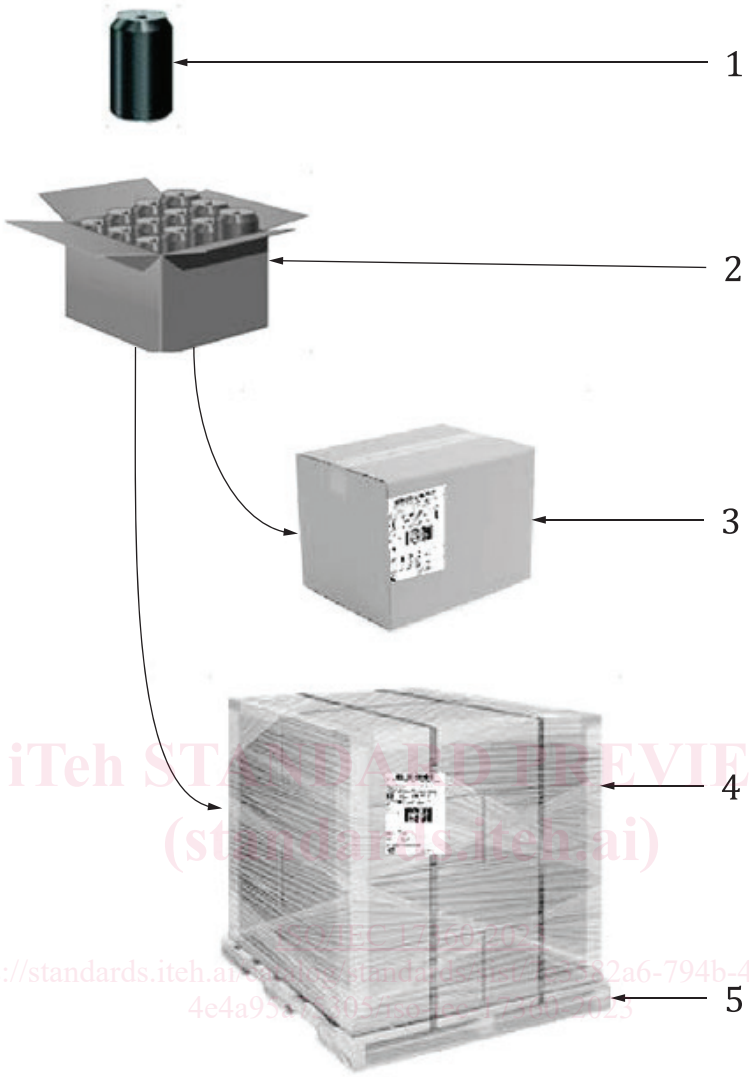
— potentially, returned goods and disposal.

Each of these levels covers many aspects of dealing with products and the business process for each level is both unique and overlaps other levels (see Annex B for additional information).

The item level through freight container level layers are addressed within the suite of standards for "supply chain applications of RFID" and are intended to enhance supply chain visibility. The movement vehicle level is not a part of the supply chain applications of RFID family of standards.

Layers 0, 1, 2 and 3 of Figure 2 are the subject of this document. Details of each of these Layers will be covered in applicable clauses of this document.

Different Layer tags can be distinguished from following, or preceding, Layer tags by the use of a *group-select* methodology contained in the RFID interrogator/reader. This *group-select* function allows the interrogator, and supporting automated information systems (AIS), to quickly identify different Layer tags.



Key

1 primary packaging (product, e.g. consumer packaging)
2 secondary packaging (outer packaging, e.g. product bulk package)
3 tertiary packaging (transport packaging, e.g. transport unit)
4 tertiary packaging (unitized transport packaging, e.g. transport unit)
5 returnable and non-returnable transport item (e.g. a pallet)

Figure 1 — Packaging

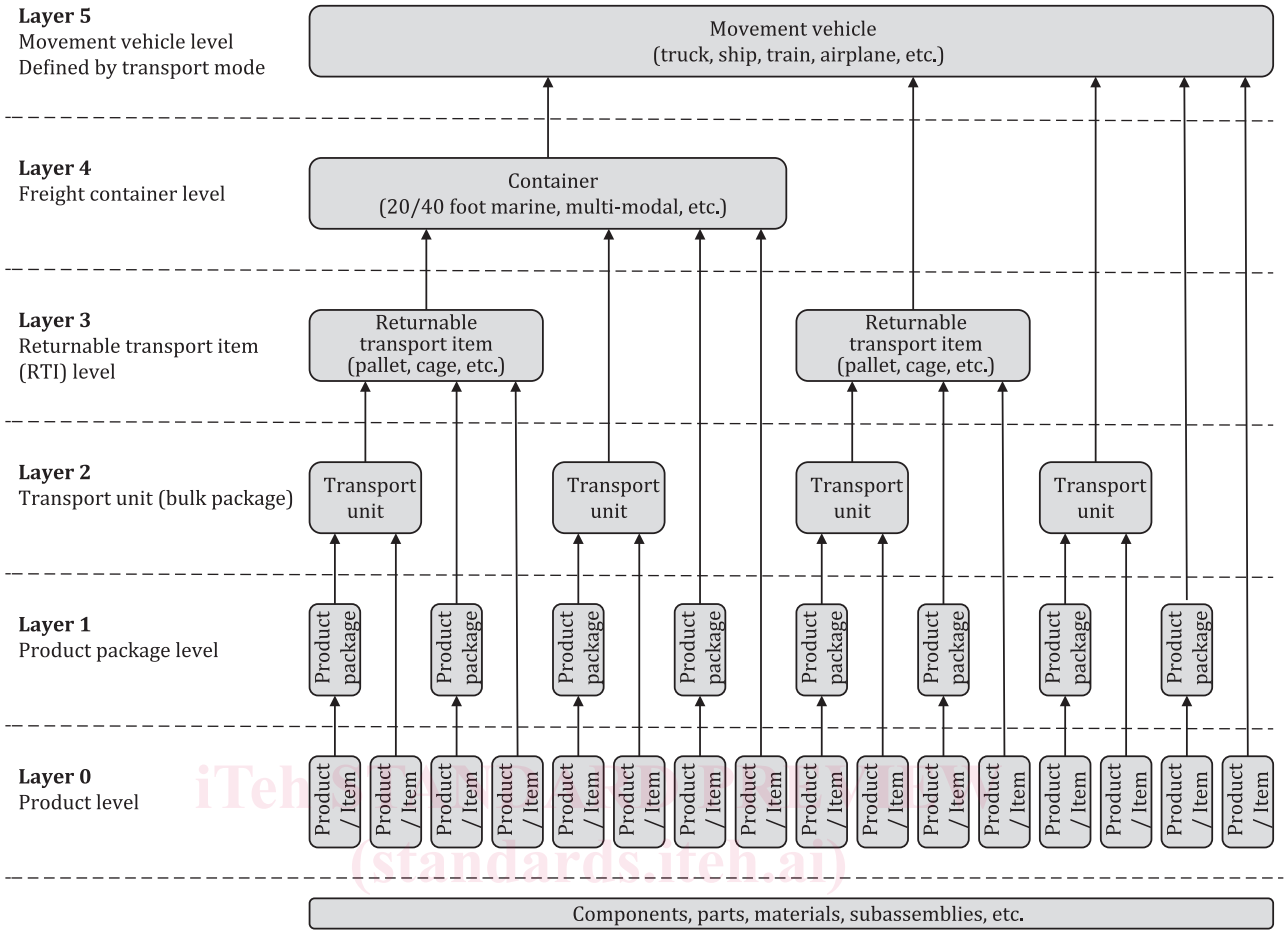


Figure 2 — Supply chain layers

5 Unique item identifier

5.1 General

Unique item identification (UII) is a process that assigns a unique data string to an individual item or in this case, to an RFID tag that is associated to the item. The unique data string is called the unique item identifier. Unique item identification of items allows data collection and management at a granular level. The benefits of having granular level data are evident in such areas as provenance, traceability, maintenance, retail warranties and enabling electronic transactions of record. The benefits are only possible if each tagged item has a unique identity.

Items that are not uniquely identified will not normally be tagged at the item level. Items to which unique item identifiers have been assigned are said to be serialized items. Traditionally, low-cost consumable items will normally be tagged at the package, or higher, level; however, recent studies have explored the ROI for tagging low-cost items.

The UII provides granular discrimination between like items that are identified with RFID tags or barcodes. See Annex C for information on using barcode labels as backup in case of RFID Tag failure. The Unique Tag ID (as defined by ISO/IEC 15963-1) is a mechanism to uniquely identify RFID tags and is not the unique product identifier defined in this document.

The minimum data elements required for unique identification are an issuing agency code (IAC), a unique enterprise identifier [Company Identification Number, (CIN)] assigned by the IAC and a serial number (SN) that is unique within that enterprise identifier.

The unique identifier of ISO/IEC 15459-1 provides identification schemes for various layers of the supply chain, from Layer 0 (products) up to Layer 3 (returnable transport items).

ISO/IEC 15459-1 and GS1 Serial Shipping Container Code (SSCC)[18] specifies the unique identification mechanisms for transport unit identification (Layer 2).

See Annex D for information on environmental factors for RFID tag operations.

5.2 UII data elements

Unique identification is provided by the minimum of the following three components:

a) IAC;

b) CIN;

c) SN.

The registration authority, as defined by ISO/IEC 15459-2, assigns the IAC. The IAC assigns the CIN. The company identified by the CIN assigns the SN. The serial number component can be composed of multiple parts – but in all cases must be a unique identifier within the CINs domain.

When using ISO/IEC 15418, the unique identity, as defined by IAC CIN SN, is preceded by an applicable ANSI MH10.8.2 Data Identifier (DI). Any applicable Data Identifier from ISO/IEC 15418 is allowed.

It is strongly recommended that once the UII has been constructed and encoded on an RFID tag that it be write-protected (locked or permalocked).

5.3 Data carrier

The data carrier/air interface shall be ISO/IEC 18000-63 or ISO/IEC 18000-3, Mode 3.

An ISO/IEC 18000-63 or ISO/IEC 18000-3, Mode 3 tags' memory is structured in three user-accessible memory banks:

a) MB01 (UII); for the purpose of this document, contains the ISO/IEC 18000-63-defined constructs of the Protocol Control bits (PC), optional Extended PC bits (XPC) and the UII.

   1) The PC bits contain flags to indicate the numbering system of the tag to be either ISO or GS1, and the existence of XPC bits and User Memory (MB11).

   2) When ISO is indicated, the PC bits contain an Application Family Identifier (AFI) that indicates the data family of the UII.

   3) The AFI is managed as specified by ISO/IEC 15961-3 and listed in the ISO/IEC 15961-2 Data Constructs Register.

      NOTE MB01 can include additional information, like tag and item flags, sensor data and other item information as indicated by the PC Bits.

b) MB10 (TID); identifies the tag according to ISO/IEC 15963-1.

c) MB11 (USER); contains user information as specified by the AFI and/or the Data Storage Format Identifier (DSFID). MB11 is optional.

As defined by the AFI, the UII format may be specified by a DSFID. The DSFID is specified and managed as described in ISO/IEC 15962 and listed in the ISO/IEC 15961-2 Data Constructs Register. The Data Constructs Register can be found in Reference [7].

5.4 Formats and encoding

5.4.1 General

Where there are application requirements to encode both the identity of the asset as well as a shipment ID or license plate, it is possible to encode these unique identities in either one or two RF tags. In the case of two tags within the ISO system, each tag will include its own unique AFI, that is, "0xA2" for license plate (shipment identification) and "0xA3" for the RTI AFI. The AFIs shall be followed by the respective ANSI MH10.8.2 Data Identifier as specified in ISO/IEC 15418. See Annex E for examples.

NOTE 1 At the time of publication of this document, assigned AFIs are: 0xA1, 0xA2, 0xA3, 0xA5, 0xAC and 0xAD. AFIs 0xA4, 0xA6, 0xA7 and 0xA8 are assigned historically for HAZMAT material and items. These AFIs are maintained for historical purposes; they are not for use by new applications. The ISO/IEC 18000-63 XPC HAZMAT flag is used to denote HAZMAT material.

NOTE 2 When using 8-bit encoding, the AFI for 8-bit encoding, 0xAC, will take precedence over and replace the AFI to denote either license plate or RTI status.

When using RFID tags, the UII for the RTI shall be written to the UII memory bank (MB01, see Figure A.1) and locked. The UII for the transport unit shall be preceded by the appropriate ANSI MH10.8.2, Category 10 license plate DI. If the license plate is to be stored on the same RFID tag, using the appropriate DI, it shall be written and locked in user memory (MB11). When combining multiple data structures, the syntax of the data shall comply with ISO/IEC 15434.

RFID tags shall have the serialized tag ID written to TID (MB10) by the manufacturers in accordance with ISO/IEC 15963-1 and permalocked.

If read-only or WORM tags are employed in identifying RTIs, two tags shall be used. One tag represents the unique transport unit identifier and the second represents the unique RTI identifier.

Subclauses 5.4.2 to 5.4.6 specify the unique item identifier methodologies that are allowed.

5.4.2 GS1 EPC bitstream encoding

For GS1 electronic product code (EPC) encoding, the numbering system identifier toggle, shown as standard toggle (T) in Figure A.2, shall be set to 0_2 (GS1). The UII shall then be an EPC as specified by GS1, *EPC Tag Data Standard (TDS)*.

5.4.3 ISO/IEC 15418 and ANSI MH10.8.2 DIs: 6-bit UII encoding

The numbering system identifier toggle, shown as standard T in Figure A.2, shall be set to 1_2 (ISO).

An ISO/IEC 15418-based UII, consisting of an applicable DI and item information, shall be encoded according to the AFI selected, as that AFI is defined by the ISO/IEC 15961-2 appointed registration authority.

When using ISO/IEC 15434-based messages within MB01, the first DI in the message shall identify the UII, which consists of IAC, CIN, and SN. It is strongly recommended that only one DI, and its data be used in MB01. In all cases, the UII shall be defined by the first DI in an ISO/IEC 15434-based message placed in MB01.

When used, multiple DIs shall be separated by the control character ${}^{G}_{S}$ (011110_2).

The messages should be terminated with the control character ${}^{E}O_{T}$ (100001_2).

Annex A provides additional details on 6-bit encoding and decoding.

5.4.4 ISO/IEC 15418 and ANSI MH10.8.2 DIs: UTF-8 8-bit UII encoding

The numbering system identifier toggle, shown as standard T in Figure A.2, shall be set to 1_2 (ISO).

The UII is encoded using UTF-8 encoding as specified by an appropriate AFI as shown in the ISO/IEC 15961-2 Data Constructs Register.

When using ISO/IEC 15434-based messages within MB01, the first DI in the message shall identify the UII, which consists of IAC, CIN, and SN. It is strongly recommended that only one DI, and its data, be used in MB01. In all cases, the UII shall be defined by the first DI in an ISO/IEC 15434-based message placed in MB01.

When used, multiple DIs shall be separated by the control character $^{G}_{S}$ (0x1D).

The messages should be terminated with the control character $^{E}O_{T}$ (0x04).

Annex A provides additional details on 8-bit encoding and decoding.

5.4.5 DSFID for ISO/IEC 15434 messages

See ISO/IEC 15961-2, Data Constructs Register, for Data Format 03 and 13 definitions, and for the specification for DSFIDs.

5.4.6 UII bitstream encoding

5.4.6.1 Encoding rules

Binary encoding provides superior benefits when encoding data that is equal to or larger than 6 characters.

The numbering system identifier toggle, shown as standard T in Figure A.2, shall be set to 1_2 (ISO).

The UII is encoded as a bitstream, as shown in Table 1, and as outlined in the steps below Table 3. It is also identified with the appropriate AFI from the ISO/IEC 15961-2 Data Constructs Register.

Table 1 — Bitstream representation of UII encoding

	UII-bitstream data elements						
UII data element	UII-Type (see Table 2)	SN-Type (see Table 3)	MB01-DS-FID-flag	MB11-DS-FID-flag	IAC+CIN (DAID encoding)	MB11-Word-Count	UII-SN (serialization)
Bit length for the data to be encoded	4 bits	2 bits	1 bit	1 bit	32, 40 or 48 bits	8 bits	n bits According to the SN-Type
Total bit length of encoded data	>48 bits to a 16-bit word boundary						

Table 2 — UII type identifier

UII-Type	UII-Type encoding value binary	Description
0	0000	General item
1	0001	Product
2	0010	Product package
3	0011	Transport unit
4	0100	Transport item

For proprietary use, a UII-Type beyond those listed in Table 2 can be used by an entity identified by an IAC CIN.

NOTE 1 There is currently no process available to assign additional UII Identifiers.

Table 3 shows the different methods of encoding the serial number element.

Table 3 — SN Type description

SN-Type	SN-Type encoding value binary	Description	Encoding rules
0	00	Decimal number.	The UII-SN shall not be followed with additional data, i.e. the UII cannot contain additional data. The UII-SN shall be padded with leading zeros.
1	01	Base-36 (hexatridecimal) number with the digit sequence "0" to "9" and then "A" to "Z".	
2	10	6-bit character set. See Table A.1.	The UII-SN shall be terminated with a complete $^{E}O_{T}$, incomplete $^{E}O_{T}$ or by the UII length, whichever comes first, or a $^{G}_{S}$ when followed by additional data.
3	11	Use the TID as the SN.	The SN shall be represented in text as an uppercase hexadecimal value. The UII may contain additional data following the MB11-word-count.

NOTE 2 For SN-Type 0, a UII length of six words (96 bits), and an IAC + CIN encoding length of 40 bits results in an SN length of 40 bits. For example, SN decimal number 222,722,086 is encoded as 0000 0000 0000 1101 0100 0110 0111 1000 0010 0110_2, which is 000D46782616.

NOTE 3 For SN-Type 1, a UII length of six words (96 bits), and an IAC + CIN encoding length of 40 bits results in an SN length of 40 bits. For example, SN hexatridecimal number "3OLPGM" is encoded as 0000 0000 0000 1101 0100 0110 0111 1000 0010 0110_2, which is 000D46782616. Various free web-based convertors are available; search for "base36 conversion".

NOTE 4 For SN-Type 0 and 1, the UII-SN length is the PC bits UII length in bits minus the length of the preceding six UII data elements (which is 48 bits, 56 bits or 64 bits).

NOTE 5 The TID is specified to be unique by ISO/IEC 15963-1 and ISO/IEC 18000-63.

The UII-bitstream encoding, as shown in Table 1, consists of the following elements:

a) UII-Type: 4 bits; value selected from Table 2.

b) SN-Type: 2 bits; value selected from Table 3.

c) MB01-DSFID-Flag (UII additional data DSFID): 1 bit.

   1) This bit is only valid for SN-Type 2 and 3. It shall be ignored (set to 0_2) for SN-Type 0 and 1.

   2) For SN-Type 2:

      — When the flag is set to 0_2, the UII-SN and the data stored in MB01 following the UII-SN shall use $^{G}_{S}$ as the data element separator, and be terminated with an $^{E}O_{T}$, incomplete $^{E}O_{T}$, or by the UII length, whichever comes first, see 5.4.6.2.

      — When the flag is set to 1_2, the data stored in MB01 following the UII-SN encoding shall start with a DSFID and follow the encoding rules of the DSFID. The UII-SN encoding and DSFID shall be separated with a $^{G}_{S}$, see 5.4.6.2.

   3) For SN-Type 3 (the encoded UII does not contain an UII-SN, since the TID is the SN):

      — When the flag is set to 0_2, the data stored in MB01 following the MB11-Word-Count uses a proprietary format. The length of the data is the PC bits UII length in bits minus the length of the preceding six UII data elements (UII-Type, SN-Type, MB01-DSFID-flag, MB11-DSFID-flag, IAC+CIN and MB11-Word-Count which is 48 bits, 56 bits, or 64 bits).

      — When the flag is set to 1_2, the data stored in MB01 following the MB11-Word-Count shall start with a DSFID and follow the encoding rules of the DSFID.