The RAIN Alliance-Issued CIN with Free-Form Encoding Schemes

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1 Purpose of the encodings

The primary objective of the RAIN Alliance-issued CIN with Free-Form encoding schemes is to enable proprietary encodings to be globally unique, thereby preventing cross-application tag interference within RAIN's many-tags-to-many-readers operational environment.

NOTE: See Annex A on how to transform existing free-form encodings into globally unique encodings using the RAIN Alliance-issued CIN with Free-Form encoding schemes.

The RAIN Alliance-issued CIN with Free-Form encoding schemes provide a method for a RAIN tag data issuer to identify their own encodings by using an ISO/IEC-compliant Company Identification Number (CIN) assigned by the RAIN Alliance.

NOTE Free-Form encodings without a CIN are not considered unique and can therefore interfere with other applications and/or be subject to interference from other applications.

Two encoding schemes are specified here to support common practices:

- AFI 0xAE: The RAIN Alliance-issued CIN followed by multiples of 8-bit bytes presented as free-form BINARY.
- AFI 0xBC: The RAIN Alliance-issued CIN followed by a free-form ASCII TEXT string (multiples of 8-bit).

The full UII encoding (the RAIN Alliance-issued CIN encoding plus the following free-form data encoding) shall be padded with 0x00 to a 16-bit boundary.

Additional data to the Free-Form encodings may be encoded in MB11 using the appropriate DSFID.

2 Terms

Term	Description	Specification
0xH…H or X…X_{hex}	A hex presented binary string, with 'H' representing a '0' to '9' and or 'A' to 'F'. Separators are used for reliability.	ISO/IEC 9899
AFI	Application Family Identifier, which is part of the PC-word.	ISO/IEC 15961 and ISO/IEC 18000-63
ASCII	The International Reference Version 7-bit character set, encoded as 8-bit bytes, i.e. the most significant bit is 0_2.	ISO 646 IRV
CIN	Company Identification Number as assigned by a registered CIN Issuing Agent.	ISO/IEC 15459

Term	Description	Specification
DSFID	Data Storage Format Identifier.	ISO/IEC 15961
Free-Form	An issuer-defined data encoding where the structure and format are not fixed by a standard, but are freely chosen by the issuer	Oxford English Dictionary — "Free-Form: not following a regular or conventional structure."
IAC	Issuing Agency Code to identify issuers of CINs.	ISO/IEC 15459
MBxx	Memory Banks 00, 01, 10 and 11 of a RAIN tag.	ISO/IEC 18000-63
PC-word	Protocol Control word which is transmitted leading the UII. Provides metadata about a tag's encoding.	ISO/IEC 18000-63
UII	Unique Item Identifier. The ISO equivalent to GS1's term "EPC".	ISO/IEC 18000-63
UserMem User Memory	MB11 of a RAIN tag.	ISO/IEC 18000-63

3 The RAIN Alliance-issued Company Identification Number

3.1 Specification

The RAIN Alliance is an ISO/IEC 15459 CIN Issuing Agency (IA) assigned the Issuing Agency Code (IAC) "XRA".

The RAIN Alliance-issued CIN is specified in *The RAIN Alliance CIN Directives*. In summary the RAIN Alliance-issued CIN is a:

- 7-, 14-, 21- and or 28-bit number
- which are can be represented as a
    - RAIN decimal CIN: 1- to 9-digit decimal number (e.g. 123456) with no leading zeros, or
    - RAIN text CIN: an equivalent 1-, 2-, 3- or 4-character case-sensitive text string using the printable subset of the 7-bit ASCII character set (ISO/IEC 646:IRV) excluding the space-character (e.g. "Ra-1").

3.2 Use and encoding

The RAIN Alliance-issued CIN may be used in all AIDC (barcodes and RAIN) item identifiers which use the ISO/IEC 15459 IAC-CIN combination. In the case of item identifiers utilizing the IAC-CIN combination based on ISO/IEC 15459, only the decimal CIN shall be used prefixed with "XRA" as the IAC.

When used with the RAIN Alliance-issued CIN with Free-Form encodings, then

- The RAIN Alliance IAC "XRA" is implicit as indicated by the AFI and is not encoded.
- The RAIN Alliance-issued CIN must be the first element of the UII followed by the Free-Form encoding. The RAIN Alliance-issued CIN is encoded as 1, 2, 3 or 4 8-bit bytes. It uses a byte-continuation indicator which is the most significant bit of each 8-bit byte:
    - 0_2 means this is the last byte of the CIN encoding.
    - 1_2 means there is a CIN encoding byte following that continues the CIN encoding.

CIN bit length	CIN bits	CIN byte encoding
7	aaaaaaa	0aaaaaaa
14	aaaaaaabbbbbbb	1aaaaaaa 0bbbbbbb
21	aaaaaaabbbbbbbccccccc	1aaaaaaa 1bbbbbbb 0ccccccc
28	aaaaaaabbbbbbbccccccddddddd	1aaaaaaa 1bbbbbbb 1ccccccc 0ddddddd

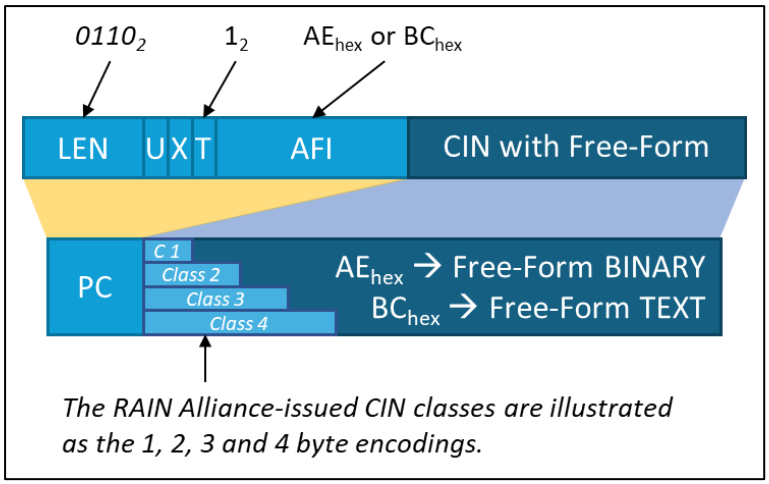
1. aaaaaaa shall be non-zero.
2. aa…a, aa…b, aa…c and aa…d is a single number when using the decimal RAIN CIN representation/format.
3. aa…a, bb…b, cc..c and dd…d is the 7-bit ASCII character encodings when using the text RAIN CIN representation/format.

4 The RAIN Alliance-issued CIN with Free-Form encoding schemes

The RAIN Alliance-issued CIN with Free-Form encoding schemes are constructed as follows:

1. In the PC word set:
    a. The UII length bits.
    b. Set T=1_2.
    c. Set the AFI:
        - For BINARY free-form data: 0xAE.
        - For ASCII TEXT string: 0xBC
2. The 1, 2, 3 or 4 8-bit byte encoding of the 7-, 14-, 21- or 28-bit the RAIN Alliance issued CIN.
3. The Free-Form encoding, BINARY or ASCII TEXT as per the selected AFI.

A 96-bit tag is illustrated below:



5 Decoding and presentation

5.1 The RAIN Alliance-issued CIN with Free-Form BINARY

The UII is BINARY encoded but generally presented as hex with the AFI.

EXAMPLE 1: AFI=0xAE, UII=0xC1C2C3444142434445464748

The RAIN Alliance-issued CIN may be decoded and presented as a decimal number.

EXAMPLE 2: AFI=0xAE, the RAIN Alliance-issued CIN=137404868, Free-Form BINARY=0x4142434445464748

5.2 The RAIN Alliance-issued CIN with Free-Form TEXT

The UII is presented as ASCII TEXT with the AFI.

EXAMPLE 1: Using the UII=0xC1C2C3444142434445464748, then AFI=0xAE, the RAIN Alliance-issued CIN="ABCD", Free-Form TEXT="ABCDEFGH"

The UII can also be presented as a single string by masking the top bit of each byte to 0_2.

EXAMPLE 2: Using the UII=0xC1C2C3444142434445464748, then AFI=0xAE, UII="ABCDABCDEFGH"

EXAMPLE 3: An entity registers with the RAIN Alliance to receive a CIN of "App-" for its application. It encodes a serial number, e.g. AB123456. The UII will be reported as "App-AB123456". The UII encoding is Len=0110_2, T=1_2, AFI=0xBC, UII=0xC1F0F02D4142313233343536.

Annex A
(informative)

How to transform existing, non-compliant free-form encodings into compliant Free-Form encodings with globally unique standards-based identifiers

Many operators/developers are reluctant to change their existing, non-compliant free-form RAIN encodings due to the perceived and real impact on the data stacks and systems. This is a legitimate concern which gives rise to:

- System costs
- Change-over complexities
- Change-over risks
- Backwards compatibility issues

It is however imperative, especially considering the massive adoption of RAIN (– 54 billion tags were issued in 2024 and growing at more than 20% year-on-year), to use a compliant globally unique tag encoding. Applications which use non-globally-unique RAIN tag encodings eventually will interfere at some time with other applications and/or will be subject to interference from other application tags. RAIN is a uniquely powerful AIDC technology for many reasons, but two of these key reasons, extended read-range and support for many-tags-to-many-reader environments, mean that any and all RAIN tags can appear in an application's read-zone.

One strategy to transition to globally unique, compliant encodings is to use *the RAIN Alliance-issued CIN with Free-Form encodings* as an "envelope" for existing, non-compliant identifiers. The additional envelope structure is then implemented only at the reader level (for both encoding and reading), which means the data stack can remain the same. See . See *RAIN Free-Form encodings*.

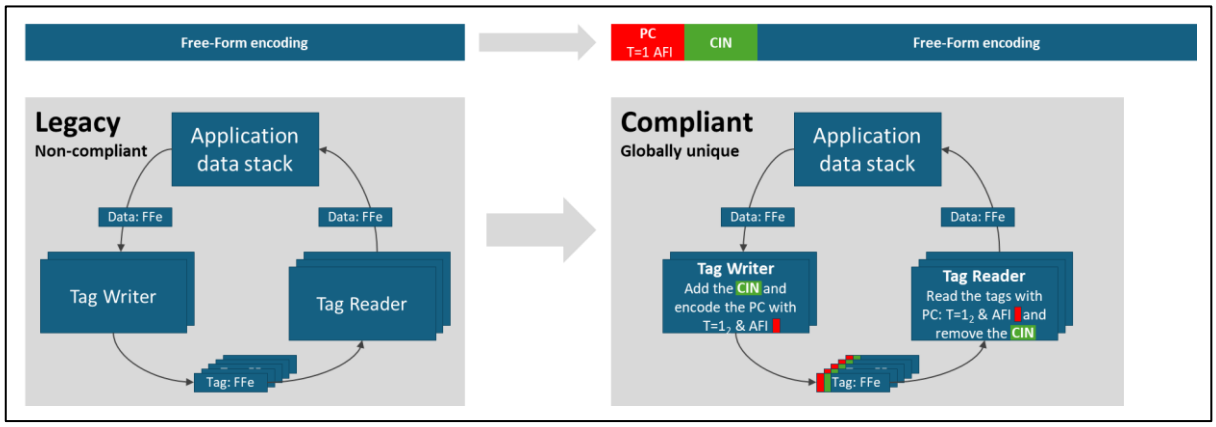
To implement this strategy and thereby ensure compliance and globally unique encodings:

- Register with the RAIN Alliance to obtain a RAIN Alliance-issued CIN.
- Use one of the AFIs specified in this document: 0xAE for BINARY free-form encodings (FFe) or 0xBC for TEXT FFe.
  NOTE: An entity may obtain and register more than one CIN, see iso/IEC 15459.
- Ensure that tag memory is sufficient to accommodate the addition of the CIN to the encoding (which is less than or equal to 32 bits).
- The device writing the tag does the following:
  - Set $T=1_2$ and the appropriate AFI of this specification in the PC word.
  - Prefix the FFe with the RAIN Alliance-issued CIN.

  NOTE: Standards-compliant RAIN readers write the PC word and UII to the tag at the same time.
- The readers reading the tags:

- Optionally select tags on T=1_2 and the appropriate AFI. All the CIN+FFe tags will be read.
- The selection can be further improved by also selecting on the CIN. Now only the user's application tags are selected and read by the reader.
- Prune the prefixed CIN (which is known), so the reader can also do filtering before pruning, and report the FFe to the host application.

- System updates required:
  - Data stack: No.
  - Readers which write the tags: Yes.
  - Readers which read tags: Yes.
- Roll-over impact: Legacy tags need still be read and reported until all are consumed.
- Future-proof: Yes, because these CIN+FFe encodings guarantee global uniqueness and application identification.



NOTE: Additional AFIs of 0x01, 0x02 and 0x03 allow for creating compliant but not globally unique RAIN encodings. For further information on the use of these AFIs, see *RAIN Free-Form Encoding Schemes*.