A New Standard for Using Official Animal Identification Schemes for Livestock Animals in RFID Applications Worldwide

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ISO New Work Item Proposal WD 23636:

- Part 1: Animal Identification Number (AIN)
- Part 2: Encoding of AIN in Short Ull in ISO/IEC 18000-63 Transponder
- Part 3: Evaluation of conformance of ISO/IEC 18000-63 Transponder
Examples of such livestock identification schemes can be found worldwide: Argentina, Brazil, France, Germany, UK, USA, and so on.

These systems make use of visual numbering on ear tags and are the backbone for registration, animal movement, tracing diseases, etc.
Part 1: Animal Identification Number
Worldwide Unique Number

Unique mobile phone number:

+ 49 173 686 0 648

Country Code
Issuing Agent
Individual Number

Registered by RA
(Telecommunication office)
Understanding the AIN:

Official USA NUES9 ear tag
The Animal Identification Number (AIN) is composed of two elements:

- **AIN Header**: 840 01
- **AIN Body**: 0 00 AXA 1234
The message will start with an AIN Header that characterizes the origin of the used scheme.

**AIN Header**

**840 01 0 00 AXA 1234**

**NCC NES**
Numeric Country Code (NCC) is a 10 bits key that defines the country of the Issuing Organization.

AIN Header: NCC

840 01 0 00 AXA 1234

NCC NES
The numbering of NCC is according ISO 3166.

<table>
<thead>
<tr>
<th>Code</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>840</td>
<td>USA</td>
</tr>
<tr>
<td>076</td>
<td>Brazil</td>
</tr>
<tr>
<td>276</td>
<td>Germany</td>
</tr>
<tr>
<td>858</td>
<td>Uruguay</td>
</tr>
</tbody>
</table>
National Encoding Scheme (NES) is an 6 bit key that defines which scheme is used for the following animal data.

Defined by the Issuing Organization and registered by Register Authority. The uniqueness is guaranteed.
There is a further scheme for bovines used in the US. It is managed by Animal Identification Number Management System (AINMS).

A different NES has to be allocated.
NES is a 6 bits key allowing 64 schemes for each country:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>NES for official schemes that carries an ISO 11784 type number.</td>
</tr>
<tr>
<td>01 - 62</td>
<td>NES for official schemes with alphanumeric representation.</td>
</tr>
<tr>
<td>63</td>
<td>NES for unofficial schemes. Uniqueness is not guaranteed.</td>
</tr>
</tbody>
</table>
AIN Body

Understanding the AIN Body:

Official Germany ear tag
AIN Body is the part of the message that represents the official number used as Visual Number and the Tagging Counter.

276  01  0  DE 03 487 70 062

* AIN Body representation of a bovine official eartag in Germany.
AIN Body: Tagging Counter

Understanding the Tagging Counter:

SISBOV eartag

Replacement SISBOV eartag
Some schemes use different color for the replacement tag.

The color of the replacement tag is represented by the Tagging Counter.

* Replacement tag example in Brazil - SISBOV.
In France, goats are identified with an RFID tag before 6 month old.

Farmers put an additional pastern RFID tag with the same number when the goat is 12 months old to use it during the milking.

* Pastern RFID tag in goats example in France.
AIN Body: Visual Number

Understanding the Visual Number representation for an alpha numeric numbering scheme:

Official Argentina ear tag
The Visual Number is composed of numeric or alpha numeric characters.

* AIN Body representation of a bovine official eartag in Argentina.
AIN Body: Visual Number

Understanding the Visual Number representation for an ISO 11784 numbering scheme:

Official Uruguay ear tag
In the case of ISO 11784 official numbering scheme, the NES is 00 and there is no Tagging Counter.

AIN Body: Visual Number

858 00

0x8000D680000F315E

* Uruguay official numbering scheme.

Eartag number 858 000000995678 example.
How to accommodate the AIN in the memory of an ISO/IEC 18000-63 Transponder?
Memory Organization of 128-bit UII

- **Bank 11**: USER
  - Word 00
  - Access Password [00..15]
  - Kill Password [00..15]
  - UII [32..47]

- **Bank 10**: TID
  - Word 00
  - UII [00..15]

- **Bank 01**: UII
  - UII [16..31]

- **Bank 00**: RESERVED
  - UII [48..63]
  - UII [64..79]
  - UII [80..95]
  - UII [96..111]
  - UII [112..127]
  - StoredPC [15..0]
  - StoredCRC [15..0]
The reader has to detect immediately whether it is:

- eartag of a bull,
- tag of a garment, or
- a transport box
An Application Family Identifier (AFI) shall be implemented according to ISO/IEC 15961-2.

There are AFI assigned from $90_h$ to $A7_h$. 
URN Code 40

Bank 11: USER
Bank 10: TID
Bank 01: UII
Bank 00: RESERVED

<table>
<thead>
<tr>
<th>Bank 00</th>
<th>00h</th>
<th>1Fh</th>
<th>0Fh</th>
<th>00h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>00h</td>
<td>1Fh</td>
<td>0Fh</td>
<td>00h</td>
</tr>
<tr>
<td></td>
<td>1Eh</td>
<td>NCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>01h</td>
<td>AFI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>StoredCRC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bank 01</th>
<th>00h</th>
<th>1Fh</th>
<th>0Fh</th>
<th>00h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>00h</td>
<td>1Fh</td>
<td>0Fh</td>
<td>00h</td>
</tr>
<tr>
<td></td>
<td>00h</td>
<td>1Fh</td>
<td>0Fh</td>
<td>00h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NCC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bank 10</th>
<th>00h</th>
<th>1Fh</th>
<th>0Fh</th>
<th>00h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>00h</td>
<td>1Fh</td>
<td>0Fh</td>
<td>00h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NCC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bank 11</th>
<th>00h</th>
<th>1Fh</th>
<th>0Fh</th>
<th>00h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>00h</td>
<td>1Fh</td>
<td>0Fh</td>
<td>00h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NCC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NCC</th>
<th>NES</th>
<th>AIN Body 1</th>
<th>AIN Body 2</th>
<th>AIN Body 3</th>
<th>AIN Body 4</th>
<th>AIN Body 5</th>
<th>AIN Body 6</th>
<th>AIN Body 7</th>
<th>AIN Body 8</th>
<th>AIN Body 9</th>
<th>AIN Body 10</th>
<th>AIN Body 11</th>
<th>AIN Body 12</th>
<th>CRC 8-bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>30h</td>
<td></td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
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<td>01h</td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
<td>9Fh</td>
</tr>
<tr>
<td>20h</td>
<td></td>
<td>1Fh</td>
<td>1Fh</td>
<td>1Fh</td>
<td>1Fh</td>
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<td>1Fh</td>
<td>1Fh</td>
<td>1Fh</td>
<td>1Fh</td>
<td>8Fh</td>
</tr>
<tr>
<td>10h</td>
<td></td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
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<td>01h</td>
<td>01h</td>
<td>7Fh</td>
</tr>
<tr>
<td>00h</td>
<td></td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
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<td>01h</td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
<td>01h</td>
<td>6Fh</td>
</tr>
</tbody>
</table>

Note: Bank 00 to Bank 11 are labeled in hexadecimal form.
The URN Code 40 coding stores 3 alpha numeric characters in a 16 bits word.

Applying this code to the AIN Body of 96 bit, allows to store 18 alpha-numeric characters.
1. Group the AIN Body:

"1105520000123456"

2. Append the null padding char (0x00) to complete 18 digits:

"1105520000123456__"
3. Separe the string in groups with 3 characters:
   “110” “552” “000” “012” “345” “6__”

4. Encode the first group using the URN 40 formula:

<table>
<thead>
<tr>
<th>String</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>Formula</th>
<th>Result (dec)</th>
<th>Result (hex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“110”</td>
<td>31</td>
<td>31</td>
<td>30</td>
<td>(1600<em>31) + (40</em>31) + 30 + 1</td>
<td>50.871</td>
<td>C6B7h</td>
</tr>
</tbody>
</table>
5. Repeat for the other groups of 3 characters:

<table>
<thead>
<tr>
<th>String</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>Formula</th>
<th>Result (dec)</th>
<th>Result (hex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“552”</td>
<td>35</td>
<td>35</td>
<td>32</td>
<td>(1600<em>35) + (40</em>35) + 32 + 1</td>
<td>57.433</td>
<td>E059 (_h)</td>
</tr>
<tr>
<td>“000”</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>(1600<em>30) + (40</em>30) + 30 + 1</td>
<td>49.231</td>
<td>C04F (_h)</td>
</tr>
<tr>
<td>“012”</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>(1600<em>30) + (40</em>31) + 32 + 1</td>
<td>49.273</td>
<td>C079 (_h)</td>
</tr>
<tr>
<td>“345”</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>(1600<em>33) + (40</em>34) + 35 + 1</td>
<td>54.196</td>
<td>D3B4 (_h)</td>
</tr>
<tr>
<td>“6__”</td>
<td>36</td>
<td>00</td>
<td>00</td>
<td>(1600<em>36) + (40</em>00) + 00 + 1</td>
<td>50.601</td>
<td>E101 (_h)</td>
</tr>
</tbody>
</table>

6. The resulting AIN Body with 12 bytes is: C6B7E059C04FC079D3B4E101 \(_h\)
StoredCRC and CRC8

- **Bank 11**: USER
- **Bank 10**: TID
- **Bank 01**: UII
- **Bank 00**: RESERVED

### StoredCRC
- **90h**: AIN Body 12
- **80h**: AIN Body 10
- **70h**: AIN Body 8
- **60h**: AIN Body 6
- **50h**: AIN Body 4
- **40h**: AIN Body 2
- **30h**: NCC, NES
- **20h**: 1Eh
- **10h**: Length
- **00h**: StoredCRC

### CRC 8-bits
- **9Fh**: AIN Body 11
- **8Fh**: AIN Body 9
- **7Fh**: AIN Body 7
- **6Fh**: AIN Body 5
- **5Fh**: AIN Body 3
- **4Fh**: AIN Body 1
- **3Fh**: AIN Body 11
- **2Fh**: AIN Body 11
- **1Fh**: AIN Body 11
- **0Fh**: AIN Body 11
StoredCRC and CRC8

CRC is Cyclic Redundancy Check. It is a check digit.

The StoredCRC is a 16-bit CRC computed over the Protocol Control (PC) and the Unique Item Identifier (UII).

It is calculated internally.
To avoid the bit flipping a CRC-8 was included. The CRC-8 is enough to protect data lengths up to 248 bits.

CRC-8 is to be applied to the DSFID + AIN header + AIN body.
Part 3 : Evaluation of conformance of ISO/IEC 18000-63 Transponder

Part 3 is under development.
Thank you!

Contact for further information:

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