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for ISO Project 15706: International Standard Audiovisual Number (ISAN)

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Method for calculating the ISAN check digit

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The ISAN number

The ISAN number is made of two elements :

- the audiovisual identifier
- the check digit associated to this audiovisual identifier

Audiovisual identifier

It is a dumb hexadecimal number made of 15 digits.

check digit

The check digit is a 1 digit hexadecimal number which purpose is to check that no errors occurs during ISAN audiovisual identifier transcription.
As detailed hereafter, the calculation of the check digit is based on ISO 7064, MOD 17,16.

The method for calculating the ISAN check digit

What is an hexadecimal number ?

The system we are used to is a base-10 number system, because for most of us we have 10 fingers.
Hexadecimal describes a base-16 number system. The numbering system is such that it contains 16 sequential numbers as base units before adding a new position to the next number.

To represent these numbers, we are using the following sixteen characters :

0123456789ABCDEF

Note that each of the above 16 digit is coded by computers as 4 binary digits (bit). One major advantage of using these numbers is that we are saving “space” (number of bits), compared with a system based on ASCII characters where each digit would be coded as 8 bits (= a byte).

The table below shows the representation of numbers in different system :

binary	decimal	hexadecimal
0	0	0
1	1	1
10	2	2
11	3	3
100	4	4
101	5	5
110	6	6
111	7	7
1000	8	8
1001	9	9

binary	decimal	hexadecimal
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F
10000	16	10
10001	17	11

Why are we using the ISO 7064 , MOD 17,16 ?

The previous method (ISO 7064 MOD 11,**10**) was relevant for decimal number, as the set of characters used to represent such numbers is made of 10 items (0,1,2,3,4,5,6,7,8,9).

We now have to handle a set of 16 characters which are (0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F).

- Thus, we will use the ISO 7064, MOD 17,16 Hybrid recursive method.

Note
For an alphanumeric string, we would have to use the ISO 7064, MOD37,36 hybrid recursive method as the set of possible characters are made of the 36 following characters : {0,..,9, A,..,Z}.

Algorithm for calculating the ISAN check digit : Hybrid system recursive method

The 15 characters of the string are processed character by character from left to right.

Let *n* the number of characters including the check digit, and *M* the modulo of the method. The 16 characters of the ISAN string (including the check digit) are numbered from right to left:
a_1 is the check digit, and a_2 to a_{16} are the characters of the audiovisual identifier.

$$\begin{cases} j=1,\ P_1=M \\ S_j = P_j|_{(M+1)} + a_{n-j+1}\ ,\ j=1..n \\ P_{(j+1)} = S_j||_M \times 2 \end{cases}$$

where

$||_M$: is the remainder after division by M. If the remainder equals 0, then $||_M = M$.
$|_{M+1}$: is the remainder after division by M+1 (never equals to 0).
a_{n-j+1} : value of a character in the string.

The check digit a_1 must be computed so that $S_n||_M = 1$.

Applying the algorithm to our problem :

n=16, M=16, M+1=17
j in {1..16}
P_1=16
a_1 is the check digit.
We want to determine the check digit for string : D98989898909898

a_{16}	a_{15}	a_{14}	a_{13}	a_{12}	a_{11}	a_{10}	a_9	a_8	a_7	a_6	a_5	a_4	a_3	a_2	**a_1**
D	9	8	9	8	9	8	9	8	9	0	9	8	9	8	**?**

Example of calculation of the ISAN check digit

ISAN core identifier : **D98989898909899**

Step	ISAN char.	Corres.	a_{n-j+1}	P_j	$P_j\|_{17}$	S_j	$S_j\|\|_{16}$	P_{j+1}
1	D	13	13	16	16	29	13	26
2	9	9	9	26	9	18	2	4
3	8	8	8	4	4	12	12	24
4	9	9	9	24	7	16	16	32
5	8	8	8	32	15	23	7	14
6	9	9	9	14	14	23	7	14
7	8	8	8	14	14	22	6	12
8	9	9	9	12	12	21	5	10
9	8	8	8	10	10	18	2	4
10	9	9	9	4	4	13	13	26
11	0	0	0	26	9	9	9	18
12	9	9	9	18	1	10	10	20
13	8	8	8	20	3	11	11	22
14	9	9	9	22	5	14	14	28
15	8	8	8	28	11	19	3	6
16			a1	6	6			

a_1 is such that : $S_{16}\|\|_{16} = 1$

As S_{16} is defined by $S_{16} = P_{16}|_{17} + a_1$, with $P_{16}|_{17} = 6$
then we must find a_1 such that : $6 + a_1 \not\equiv 1$ (MOD 16) (i.e. $(6+ a_1 -1)$ is divisible by 16 or $(6+ a_1)$ and 1 have the same remainder when divided by 16).

In our example : it gives $a_1 = 11$, which corresponds to the letter B in hexadecimal notation.

- The ISAN is therefore : **D98989898909899-B**