
**Information technology — Security
techniques — Random bit generation**

**AMENDMENT 1: Deterministic random
bit generation**

*Technologies de l'information — Techniques de sécurité —
Génération de bits aléatoires*

AMENDEMENT 1: Génération déterministe de bits aléatoires

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Add a new Annex K.

Annex K (informative) Example cases for MQ_DRBG

K.1 General

Annex K and its supporting files provides example cases for 14 settings listed in ISO/IEC 18031:2011, Table C.5. The supporting files are available at the following URL:

<http://standards.iso.org/iso/18031/>

In each of the 14 settings described in Annex K, the bitstring P provides a randomly selected system of multivariate quadratic equations that complies with the selection rules of C.5.2.5. The rank distribution resulting from the verification of rank conditions is detailed for each setting.

P is given in the format described in C.5.2.4 which is recalled below. Each example case also includes a sequence of consecutive input-output pairs for the **Evaluate_MQ(...)** function.

K.1.1 Format for representing field elements

Each system coefficient is an element of the binary field $\text{GF}(2^{\text{field_size}})$ and is a univariate polynomial over $\text{GF}(2)$ modulo the irreducible polynomial given in Table C.6. A field element is handled as a bitstring of field_size bits composed of its $\text{GF}(2)$ coefficients ordered by decreasing degree. For example, the polynomial $x^3 + x + 1$ in $\text{GF}(2^4)$ is represented as the bitstring 1011.

K.1.2 Format for representing a single multivariate quadratic equation

The quadratic system used in MQ_DRBG operates on $n = \text{state_length} / \text{field_size}$ variables and contains $n + m$ equations where $m = \text{block_length} / \text{field_size}$. A quadratic equation is written as the concatenation of its coefficients in lexicographic order and by decreasing degree. Therefore the coefficient of the monomial x_1x_1 appears first, followed by that of x_1x_2 and so forth, up to the coefficient of x_1x_n . The coefficient of the monomial x_2x_2 appears next, followed by that of x_2x_3 and so forth, until the last quadratic coefficient $x_{n-1}x_n$ is reached. Then linear coefficients appear, starting with the coefficient of the monomial x_1 and ending with that of x_n . When $\text{field_size} = 1$, the linear coefficients are omitted since the underlying field is $\text{GF}(2)$ and $x_ix_i = x_i$. The string ends with the constant coefficient of the quadratic equation.

K.1.3 Format for representing a complete system of quadratic equations

The quadratic system encoded into the bitstring P contains its $n + m$ quadratic equations concatenated in sequential order, starting with the coefficients of the first equation and ending with those of the $(n+m)$ -th equation. P is formed by the resulting bit string of length system_length .

K.1.4 Format for representing inputs and outputs

The input x to **Evaluate_MQ**(P, x) is a vector of n field elements and is given as a bitstring formed by concatenating their bitstring representations, starting with x_1 and ending with x_n . Similarly, the output $y || z$ is a vector of $n + m$ field elements represented in the same format.

K.1.5 Summary of example cases

[Table K.1](#) summarizes the 14 example cases.

Table K.1 — Summary of example cases

<i>requested_strength</i>	<i>block_length</i>			
	112	128	192	256
80	K.2 Binary field GF(2) $n = 112$ $m = 112$ $\min_weight = 4$ $\min_rank \geq 106$	K.4 Binary field GF(2 ⁴) $n = 32$ $m = 32$ $\min_weight = 5$ $\min_rank \geq 30$	K.7 Binary field GF(2 ⁶) $n = 32$ $m = 32$ $\min_weight = 5$ $\min_rank \geq 30$	K.11 Binary field GF(2 ⁸) $n = 32$ $m = 32$ $\min_weight = 5$ $\min_rank \geq 30$
112	K.3 Binary field GF(2) $n = 120$ $m = 112$ $\min_weight = 4$ $\min_rank \geq 114$	K.5 Binary field GF(2) $n = 128$ $m = 128$ $\min_weight = 4$ $\min_rank \geq 122$	K.8 Binary field GF(2 ⁴) $n = 48$ $m = 48$ $\min_weight = 5$ $\min_rank \geq 44$	K.12 Binary field GF(2 ⁴) $n = 64$ $m = 64$ $\min_weight = 5$ $\min_rank \geq 60$
128		K.6 Same as K.5	K.9 Binary field GF(2 ³) $n = 64$ $m = 64$ $\min_weight = 5$ $\min_rank \geq 60$	K.13 Same as K.12
192			K.10 Binary field GF(2) $n = 200$ $m = 192$ $\min_weight = 4$ $\min_rank \geq 192$	K.14 Binary field GF(2 ²) $n = 128$ $m = 128$ $\min_weight = 5$ $\min_rank \geq 124$
256				K.15 Binary field GF(2) $n = 272$ $m = 256$ $\min_weight = 4$ $\min_rank \geq 264$

K.2 Example case for *requested_strength* = 80 and *block_length* = 112

K.2.1 System of multivariate quadratic equations

The bitstring P containing the system coefficients is provided in digital form in the file “coefficients-BL-112-Sec-80-F2.bin” in accordance with the format described in K.1.3.

The file contains 177212 bytes and its SHA-1 checksum in hexadecimal form is

95d78546df132777af932886a887da96aa9afa46

The ranks are distributed as follows:

106: 4561

108: 2213145

110: 58156950

112: 43613144

Sum: 103987800

K.2.2 Inputs and outputs

The bitstrings x , y and z are provided in digital form in accordance with the format described in K.1.4. Their hexadecimal values are:

$x = 00000000000000000000000000000001$

$y = \text{bb8cf180cbc3a6002c19c770ed0d}$

$z = 7847b864cfadf70fb359203e06d8$

$x = \text{bb8cf180cbc3a6002c19c770ed0d}$

$y = \text{a1e0811b5b7733113ca8e22dd2b1}$

$z = 57d27f7b0fc67aec0d5e8115cd93$

$x = \text{a1e0811b5b7733113ca8e22dd2b1}$

$y = 634ae5294dbc4cc79ce11cfeb1d7$

$z = \text{c42c5cc5b5b61396df3fcf7a4e2b}$

$x = 634ae5294dbc4cc79ce11cfeb1d7$

$y = 36701faea23130a0407a44f5e420$

$z = \text{bf3ddd3cbb141fcd96cbba66ebb9}$

$x = 36701faea23130a0407a44f5e420$

$y = 74b5baa1095f61eb6b15d317d5ed$