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Information technology — Security techniques — Lightweight cryptography —

Part 5: Hash-functions

Technologies de l'information — Techniques de sécurité — Cryptographie pour environnements contraints —

Partie 5: Fonctions de hachage

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, SC 27, *IT Security techniques*.

ISO/IEC 29192 consists of the following parts, under the general title *Information technology — Security techniques — Lightweight cryptography*:

— *Part 1: General*

— *Part 2: Block ciphers*

— *Part 3: Stream ciphers*

— *Part 4: Mechanisms using asymmetric techniques*

— *Part 5: Hash-functions*

Further parts may follow.

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Introduction

This part of ISO/IEC 29192 specifies lightweight hash-functions, which are tailored for implementation in constrained environments.

ISO/IEC 29192-1 specifies the requirements for lightweight cryptography.

A hash-function maps an arbitrary string of bits to a fixed-length string of bits.

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Information technology — Security techniques — Lightweight cryptography —

Part 5: Hash-functions

1 Scope

This part of ISO/IEC 29192 specifies three hash-functions suitable for applications requiring lightweight cryptographic implementations.

— PHOTON: a lightweight hash-function with permutation sizes of 100, 144, 196, 256 and 288 bits computing hash-codes of length 80, 128, 160, 224, and 256 bits, respectively.

— SPONGENT: a lightweight hash-function with permutation sizes of 88, 136, 176, 240 and 272 bits computing hash-codes of length 88, 128, 160, 224, and 256 bits, respectively.

— Lesamnta-LW: a lightweight hash-function with permutation size 384 bits computing a hash-code of length 256 bits.

The requirements for lightweight cryptography are given in ISO/IEC 29192-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 29192-1, *Information technology — Security techniques — Lightweight cryptography — Part 1: General*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
absorbing phase
input phase of a sponge function

[SOURCE: [4]]

3.2
bitrate
part of the internal state of a sponge function of length r bits

[SOURCE: [4]]

3.3
capacity
part of the internal state of a sponge function of length c bits

[SOURCE: [4]]

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3.4
collision resistance
computationally infeasible to find any two distinct inputs which map to the same output of a hash-function

Note 1 to entry: Computational feasibility depends on the specific security requirements and environment.

3.5
hash-code
string of bits which is the output of a hash-function

Note 1 to entry: The literature on this subject contains a variety of terms that have the same or similar meaning as hash-code. Modification Detection Code, Manipulation Detection Code, digest, hash-result, hash-value and imprint are some examples.

[SOURCE: ISO/IEC 10118-1:—[1)], 2.3]

3.6
hash-function
function which maps strings of bits to fixed-length strings of bits, satisfying the following two properties:

— it is computationally infeasible to find for a given output, an input which maps to this output;

— it is computationally infeasible to find for a given input, a second input which maps to the same output

Note 1 to entry: Computational feasibility depends on the specific security requirements and environment.

[SOURCE: ISO/IEC 10118-1:—[1)], 2.4]

3.7
initializing value
value used in defining the starting point of a hash-function

Note 1 to entry: The literature on this subject contains a variety of terms that have the same or similar meaning as initializing value. Initialization vector and starting value are examples.

[SOURCE: ISO/IEC 10118-1:—[1)], 2.5]

3.8
preimage resistance
computationally infeasible to find for a given output of a hash-function, an input which maps to this output

Note 1 to entry: Computational feasibility depends on the specific security requirements and environment.

3.9
second preimage resistance
computationally infeasible to find for a given input of a hash-function, a second input which maps to the same output

Note 1 to entry: Computational feasibility depends on the specific security requirements and environment.

3.10
sponge function
mode of operation, based on a fixed-length permutation (or transformation) and a padding rule, which builds a function mapping variable-length input to variable-length output

[SOURCE: [4]]

1) To be published. (Revision of ISO/IEC 10118-1:2000)

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3.11
squeezing phase
output phase of a sponge function

[SOURCE: [4]]

4 Symbols

$\{0\}^c$	bit-string containing exactly c zeros
0x	prefix indicating a binary string in hexadecimal notation
||	concatenation of bit strings
$a \leftarrow b$	set variable a to the value of b
$\oplus$	bitwise exclusive-OR operation
c	length of the capacity in bits
hash	n-bit hash-code
IV	t-bit initialization value
m_i	message block i of r bits
n	length of the hash code in bits
r	length of the bitrate in bits
S_i	t-bit internal state at iteration i
t	length of the internal state in bits
$\lceil x \rceil$	the smallest integer greater than or equal to the real number x

5 Lightweight hash-functions optimized for hardware implementations

5.1 General

Clause 5 specifies PHOTON and SPONGENT hash-functions which are optimized for hardware implementations. ISO/IEC 29192-1 shall be referred to for the requirements for lightweight cryptography.

5.2 PHOTON

5.2.1 General

In order to cover a wide spectrum of applications, five different variants of PHOTON[5] are specified. Each variant is defined by its internal permutation size $t = c + r$, where c and r denote the *capacity* and the *bitrate*, respectively. For a fixed permutation size t, the choice of c and r provides a security-efficiency trade-off. PHOTON-t denotes the variant using a t-bit internal permutation.

The five variants are the following:

a) **PHOTON-100** computes an 80-bit hash-code and offers 64-bit preimage resistance, 40-bit second preimage resistance, and 40-bit collision resistance.

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