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Information security — Anonymous entity authentication —

Part 3: Mechanisms based on blind signatures

Sécurité de l'information — Authentification d'entité anonyme —

Partie 3: Mécanismes fondés sur des signatures aveugles

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 27, *Information security, cybersecurity and privacy protection*.

A list of all parts in the ISO/IEC 20009 series can be found on the ISO and IEC websites.

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Introduction

In an anonymous entity authentication mechanism, the entity to be authenticated (the claimant) provides evidence to a verifier that it has knowledge of a secret without revealing its identifier to any unauthorized entity. That is, given complete knowledge of the messages exchanged between the parties, an unauthorized entity cannot discover the identifier of the entity being authenticated. Moreover, it is possible that even an authorized verifier is not authorized to learn the identifier of the entity being authenticated.

The anonymous entity authentication mechanisms specified in this document are based on blind signatures, specified in the ISO/IEC 18370 series.

Information security — Anonymous entity authentication —

Part 3: Mechanisms based on blind signatures

1 Scope

This document provides general descriptions and specifications of anonymous entity authentication mechanisms based on blind digital signatures.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
anonymous entity authentication
corroboration that an entity possesses certain *attributes* (3.2), without distinguishing this entity from other entities with the same attributes

[SOURCE: ISO/IEC 20009-1:2013, 2.2]

3.2
attribute
application-specific data element

[SOURCE: ISO/IEC 18370-1:2016, 3.1]

3.3
claimant
entity which is or represents a principal for the purposes of authentication

Note 1 to entry: A claimant includes the functions and the private data necessary for engaging in authentication exchanges on behalf of a principal.

[SOURCE: ISO/IEC 9798-1:2010, 3.6]

3.4
claimant information field
special *credential* (3.6) *attribute* (3.2) encoded within a credential that is not seen by the *issuer* (3.13) during credential issuance, and that is always disclosed to a *verifier* (3.15)

3.5
collision-resistant hash-function
hash-function (3.12) satisfying the following property: it is computationally infeasible to find any two distinct inputs which map to the same output

[SOURCE: ISO/IEC 10118-1:2016, 3.1, modified — Note 1 to entry has been deleted.]

3.6
credential
data held by a *claimant* (3.3) that provides evidence that the claimant is the rightful holder of encoded *attributes* (3.2) and/or a public key, corresponding to a private key

Note 1 to entry: In the context of this definition, attributes can include information regarding the qualification, competence or clearance of the claimant.

3.7
credential information field
special *attribute* (3.2) encoded within a *credential* (3.6) that contains metadata about the credential, such as its expiry date, that is always disclosed to *verifiers* (3.15)

3.8
credential private key
data item specific to a *claimant's* (3.3) *credential* (3.6) that should only be used by this claimant

3.9
credential public key
data item mathematically related to a *credential* (3.6) that is disclosed to the *verifier* (3.15) upon authentication

3.10
domain
set of entities operating under a single security policy

[SOURCE: ISO/IEC 18370-1:2016, 3.11]

3.11
domain parameter
data element which is common to and known by or accessible to all entities within the *domain* (3.10)

[SOURCE: ISO/IEC 14888-1:2008, 3.5]

3.12
hash-function
function which maps strings of bits of variable (but usually upper bounded) length to fixed-length strings of bits, satisfying the following two properties:

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

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

[SOURCE: ISO/IEC 10118-1:2016, 3.4, modified — Note 1 to entry has been deleted.]

3.13
issuer
entity responsible for provisioning of a *credential* (3.6) to a *claimant* (3.3)

3.14
unilateral anonymous authentication
anonymous entity authentication (3.1) that provides one entity with assurance of the legitimacy of the other entity, but not vice versa

[SOURCE: ISO/IEC 20009-1:2013, 2.20]

3.15
verifier
entity which requires assurance of the legitimacy of another entity (the *claimant* (3.3))

[SOURCE: ISO/IEC 20009-1:2013, 2.22]

4 Symbols and abbreviated terms

$\emptyset$	The null value, a zero-length octet string.
`0x`	Prefix of a hexadecimal value. For example, `0x37c5` represents the two octet values `37` and `c5` in sequence.
$a \in A$	Indicates that element is in set A.
$a\|\|b$	Concatenation of data items a and b in the order specified. In cases where the result of concatenating two or more data items is input to a cryptographic algorithm as part of one of the mechanisms specified in this document, this result shall be composed so that it can be uniquely resolved into its constituent data strings, i.e. so that there is no possibility of ambiguity in interpretation. This latter property can be achieved in a variety of different ways, depending on the application. For example, it can be guaranteed by: a) fixing the length of each of the substrings throughout the domain of use of the mechanism; or b) encoding the sequence of concatenated strings using a method that guarantees unique decoding, e.g. using the distinguished encoding rules defined in ISO/IEC 8825-1.
$A \subseteq B$	Indicates that set A is a subset of or equal to set B.
A \ B	When A and B are sets, represents the set of elements present in A but not in B.
CI	An extra claimant information field.
$cred$	The claimant's credential.
$\|D\|$	Bit length of D if D is a bit string, or bit size of D if D is a non-negative number (i.e. 0 if $D = 0$, or the unique integer i such that $2^{i-1} \leq D < 2^i$ if $D > 0$).
$desc(G_q)$	Specifies a group G_q of prime order q in which it is infeasible to compute discrete logarithms.
E	Elliptic curve over the finite field F_p for a prime $p > 3$.
$E(F_p)$	Set of all points (x, y), $x \in F_p$, $y \in F_p$, which satisfy the defining equation of the curve E, together with the point at infinity O_E.
$\#E(F_p)$	Order (or cardinality) of $E(F_p)$.
F_p	Finite field containing exactly p elements.
g, g_i	Generators of G_q.
$\gcd(N_1, N_2)$	Greatest common divisor of integers N_1 and N_2.

G_q	Cyclic group of prime order q. For uniformity, the multiplicative notation is used throughout. As such, when using the elliptic curve construction it should be understood that ab represents the group addition of points a and b, that a/b represents the group addition of the point a to the additive inverse of the point b, and that a^b represents the scalar multiplication of point a by the integer b. NOTE This document specifies two constructions for the group G_q in which it is infeasible to compute discrete logarithms. The first is based on a subgroup of a finite field, and the second is based on an elliptic curve over a finite field F_q, where q is a prime number. Each construction is specified by a description denoted by $desc(G_q)$. Details of these two constructions with their corresponding descriptions $desc(G_q)$ are provided in Annex C.
H	Cryptographic hash-function.
I	Finite set of positive integers.
k	Security parameter (a positive integer).
l_q	Security parameter (a positive integer).
n	Positive integer.
$[n]P$	Scalar multiplication operation that takes a positive integer n and a point P on the elliptic curve E as input and produces as output another point Q on the elliptic curve E, where $Q = [n]P = P + P + \ldots + P$ added $n - 1$ times. The operation satisfies $[0]P = O_E$ (the point at infinity), and $[-n]P = [n](-P)$.
O_E	Point at infinity on the elliptic curve E.
$P + Q$	Elliptic curve sum of points P and Q.
q	Prime number satisfying $\lvert q \rvert = l_q$.
TI	A credential information field.
UID_p	A unique identifier for the domain parameters.
Z_p	Set of integers in $[0, p - 1]$ with arithmetic defined modulo p.
Z_N^*	Set of integers U with $0 < U < N$ and $\gcd(U, N) = 1$, with arithmetic defined modulo N.
$\prod_{i \in I} a_i$	Product of the values a_i for which $i \in I$.
$[x, y]$	Set of integers from x to y inclusive, if x, y are integers satisfying $x \leq y$.
$\langle \ldots \rangle$	Ordered list of values to be hashed.

5 General model and requirements

This clause specifies the general model and requirements for the mechanisms specified in this document.

NOTE 1 Blind signatures, as specified in the ISO/IEC 18370 series, allow a user to obtain a digital signature as specified in the ISO/IEC 9796 series on a message of the user's choice, without giving the signer any information about the actual message or the resulting signature.

An anonymous entity authentication mechanism based on blind signatures involves an issuer, a set of claimants and a set of verifiers. Such an anonymous entity authentication mechanism is defined by the specification of the following processes:

— parameter generation process;

— key generation process;

— credential issuance process;

— authentication process.

Entities of different types can be involved in the mechanism specified in this document, as follows.

— Claimant: an entity to be authenticated in such a way that the claimant's identity is not revealed. In this document, a claimant plays the role of requestor in a blind digital signature scheme, as specified in ISO/IEC 18370-2:2016.

— Verifier: an entity that verifies the validity of a claimant's credential and which does not learn the claimant's identity.

— Issuer: an entity issuing a credential to a claimant. In this document, an issuer plays the role of signer in a blind digital signature scheme as specified in ISO/IEC 18370-2:2016.

NOTE 2 In the context of this document, the issuer serves as an offline trusted third party (TTP) in the sense of ISO/IEC 20009-1. It gains knowledge of all a claimant's attributes but does not learn which subset is later selected to present the signature.

Annex A lists the object identifiers which shall be used to identify the mechanism defined in this document.

6 Unilateral anonymous authentication

6.1 General

Unilateral anonymous authentication means that only one of the two entities, the claimant, is authenticated by use of the mechanism and that the identity of the authenticated entity is anonymous to the other entity, the verifier.

6.2 Mechanism 1 — Two-pass unilateral anonymous authentication

6.2.1 General

Two-pass means that the authentication phase consists of two messages being exchanged between the claimant and the verifier.

This mechanism is based on mechanism 4 in ISO/IEC 18370-2:2016. In addition to verifying that a claimant possesses a valid credential issued by the issuer, this mechanism also enables a verifier to request the presentation of claimant attributes encoded in the credential. That is, at the end of the authentication process, the verifier is guaranteed that the claimant holds a credential received from the issuer that certifies the attributes disclosed during the authentication process.

The mechanism only guarantees anonymity to the claimant if a credential received from the issuer is used in only one session of the authentication process. If a credential is used in multiple sessions, these sessions can still not be linked to the corresponding session of the credential issuance process. However, they can be linked with each other by the verifiers, even if different sets of attributes are disclosed. In particular, a returning claimant can be recognized by a verifier.

Security considerations and guidance for concrete parameter selections are given in Annex E.

6.2.2 Requirements

In order to use this two-pass unilateral anonymous authentication mechanism, the following requirements apply.

— Each entity involved in this mechanism shall be aware of the public domain parameters.

— The parties shall agree on the security parameters in use.

NOTE 1 Guidance for parameter choice is given in Clause E.2.