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Information technology — Biometric presentation attack detection —

Part 2: Data formats

Technologies de l'information — Détection d'attaque de présentation en biométrie —

Partie 2: Format des données

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

A list of all parts in the ISO/IEC 30107 series can be found on the ISO website.

Introduction

The presentation of an artefact or of human characteristics to a biometric capture subsystem in a fashion that could interfere with the intended policy of the biometric system is referred to as a presentation attack. The ISO/IEC 30107 series is concerned with mechanisms for the automated detection of presentation attacks. These mechanisms are called presentation attack detection (PAD) mechanisms.

This document establishes common data formats for conveying the type of approach used in presentation attack detection and for conveying the results of presentation attack detection methods. This document specifies the meaning of the data elements used in the PAD data formats (see Clause 5), a tagged binary PAD data format based on an extensible specification in ASN.1 (see A.1), and a textual PAD data format based on an XML schema definition (see A.2). Annex A containing the formal specifications is normative. The informative Annex B gives encoding examples.

Information technology — Biometric presentation attack detection —

Part 2: Data formats

1 Scope

This document defines data formats for conveying the mechanism used in biometric presentation attack detection and for conveying the results of presentation attack detection methods. The attacks considered in the ISO/IEC 30107 series take place at the sensor during the presentation and collection of the biometric characteristics. Any other attacks are outside the scope of this document.

This document contains the following data formats: a binary format and an XML schema. The data interchange formats in this document are generic, in that they may be applied and used in a wide range of application areas. No application-specific requirements are addressed here.

Provisions for the cryptographic protection of the authenticity, integrity, and confidentiality of stored and transmitted presentation attack detection data are beyond the scope of this document.

NOTE While addressing security is out of the scope of this document, PAD data may be protected by encoding them into a biometric information record (see ISO/IEC 19785-1) that includes an optional security block.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 80000 (all parts), *Quantities and units*

ISO/IEC 2382-37, *Information technology — Vocabulary — Part 37: Biometrics*

ISO/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO/IEC 8825-1, *Information technology — ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

ISO/IEC 19785-1, *Information technology — Common Biometric Exchange Formats Framework — Part 1: Data element specification*

ISO/IEC 30107-1, *Information technology — Biometric presentation attack detection — Part 1: Framework*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 2382-37 and ISO/IEC 30107-1 apply.

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

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

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

4 Conformance

A block of presentation attack detection (PAD) data shall be conformant to this document if it conforms to the normative requirements of Clause 5 and A.1 or A.2, respectively.

5 Data elements

5.1 Overview

Clause 5 contains a description of the data that may be generated by the PAD subsystem and used by a relying system. This data may be generated at any point in the system. Consequently, the PAD data available for a biometric sample may change at any stage in the collection and subsequent processing of the biometric sample. PAD subsystems have data inputs (such as thresholds, biometric samples, and secondary data streams, e.g. measures of conductance, reflectance, inductance, ECG, and challenge/response pairs) and provide output data.

Data relevant to PAD includes both input and output data streams. Output data may include:

a) an indication of whether PAD data is available (beyond that intrinsically embedded in the biometric signals);

b) an indication of whether a PAD decision has been made and, if so, the nature of the decision;

c) PAD score;

d) vector of partial PAD results;

e) any extended PAD data that accompanies the biometric sample;

f) identifiers of PAD mechanisms (PAD mechanism vendor identifier, PAD mechanism identifier, PAD extended data mechanism vendor identifier, and PAD extended data mechanism identifier).

Input data may include:

a) context of the capture — enrolment, verification, or identification;

b) level of supervision/surveillance during the capture process;

c) current risk level, e.g. recent attack activity;

d) category of criteria for PAD, i.e. the criteria are common for all subjects (global), are specific to each subject or are unknown;

e) any external parameters sent to be used in the PAD process;

f) any challenges that were given to the data capture subject;

g) PAD data capture date and time;

h) identifiers of the capture device (capture device vendor identifier, capture device model identifier, and capture device serial number).

NOTE Because there is a loose spatial and temporal binding between biometric samples and PAD data, the PAD output data need not be related only to a single acquired biometric sample. The PAD data may apply to other samples acquired during the transaction as well.

If physical and/or chemical magnitudes are included in the record, those magnitudes shall be expressed in units of the International System of Units (SI), as stated in ISO 80000 (all parts).

5.2 PAD output

5.2.1 PAD decision

Presence: Optional

Abstract values: ATTACK, NO_ATTACK, and FAILURE_TO_COMPUTE

NOTE The encoding of the abstract values in the tagged binary format is defined in A.1. The encoding of the abstract values in XML is defined in A.2.

Contents: If present, this data element shall indicate whether a presentation attack attempt has been detected by the PAD subsystem. The abstract value ATTACK shall indicate that a presentation attack attempt has been detected by the PAD subsystem. The abstract value NO_ATTACK shall indicate that no presentation attack attempt has been detected by the PAD subsystem. The abstract value FAILURE_TO_COMPUTE shall indicate that the PAD decision process has failed.

5.2.2 PAD mechanism vendor identifier

Presence: Optional

Abstract values: Integers 1 to 65 535

Contents: If present, this data element shall identify the vendor of the PAD mechanism. The vendor identifier shall be registered with the Biometric Registration Authority identified in ISO/IEC 19785-1.

5.2.3 PAD mechanism identifier

Presence: Conditional. This data element shall be included if and only if the PAD mechanism vendor identifier is present.

Abstract values: Integers 1 to 65 535

Contents: If present, this data element shall identify the PAD mechanism (referred to as PAD technique in ISO/IEC 19785-1). The PAD mechanism identifier shall be assigned by the PAD mechanism vendor.

Table 1 lists PAD mechanism identifiers for PAD approaches not connected with a particular vendor. For the PAD mechanism identifiers listed in Table 1, the biometric organization identifier of ISO/IEC JTC 1/SC 37, which is 257 (0101_{Hex}), shall be used as the PAD mechanism vendor identifier. These identifiers have been registered with the Biometric Registration Authority identified in ISO/IEC 19785-1.

Table 1 — PAD mechanism identifiers for PAD approaches not connected with a particular vendor

PAD mechanism vendor identifier	PAD mechanism identifier	Description
257 (0101_{Hex})	1 (0001_{Hex})	Challenge/involuntary response
257 (0101_{Hex})	2 (0002_{Hex})	Challenge/voluntary response
257 (0101_{Hex})	3 (0003_{Hex})	Challenge/response as a combination of what you are and know
257 (0101_{Hex})	4 (0004_{Hex})	Non-stimulated observation of liveness

5.2.4 PAD score

Presence: Optional

Abstract values: Integers 0 to 100 and FAILURE_TO_COMPUTE

Contents: If present, this data element shall indicate the PAD result as a score between 0 and 100. Bona-fide presentations shall tend to generate lower scores. Presentation attacks shall tend to generate higher scores. The abstract value FAILURE_TO_COMPUTE shall indicate that the computation of the PAD score has failed.

If the PAD score value is FAILURE_TO_COMPUTE, then, if present, the PAD decision value shall also be FAILURE_TO_COMPUTE.

5.2.5 PAD extended data mechanism vendor identifier

Presence: Conditional. This data element shall be included if and only if PAD extended data is present.

Abstract values: Integers 1 to 65 535

Contents: If present, this data element shall identify the vendor of the PAD mechanism used in the PAD extended data. The vendor identifier shall be registered with the Biometric Registration Authority identified in ISO/IEC 19785-1.

5.2.6 PAD extended data mechanism identifier

Presence: Conditional. This data element shall be included if and only if the PAD extended data vendor identifier is present.

Abstract values: Integers 1 to 65 535

Contents: If present, this data element shall identify the PAD mechanism used in the PAD extended data. The PAD extended data mechanism identifier shall be assigned by the PAD extended data mechanism vendor. The PAD mechanism identifier should be registered with the Biometric Registration Authority identified in ISO/IEC 19785-1.

NOTE ISO/IEC 19785-1:2015, 6.1.6 states that registration of biometric product identifiers is optional.

5.2.7 PAD extended data

Presence: Optional

Abstract values: Any octet string

Contents: If present, this data element shall include additional PAD-related information that cannot be held by the data elements defined above. The structure of this data is defined by the vendor of the identified mechanism.

5.3 PAD input

5.3.1 Context of capture

Presence: Optional

Abstract values: ENROLMENT, VERIFICATION, IDENTIFICATION

Contents: If present, this data element shall indicate the context of the capture process. The abstract value ENROLMENT shall indicate that the context of the capture process is enrolment. The abstract value VERIFICATION shall indicate that the context of the capture process is biometric verification. The abstract value IDENTIFICATION shall indicate that the context of the capture process is biometric identification.

5.3.2 Level of supervision/surveillance

Presence: Optional

Abstract values: UNKNOWN, CONTROLLED, ASSISTED, OBSERVED, UNATTENDED

Contents: If present, this data element shall indicate the level of supervision/surveillance during the capture process. Biometric authentication may be performed under a variety of conditions ranging from controlled to unattended, as shown in Table 2, which is based on Reference [4].

Table 2 — Device monitoring modes

Abstract value	Description
UNKNOWN	No information is known.
CONTROLLED	An operator physically controls the biometric capture subject to acquire biometric samples.
ASSISTED	A person is available to provide assistance to the biometric capture subject submitting the biometric characteristics.
OBSERVED	A person is present to observe operation of the device but provides no assistance[a].
UNATTENDED	No one is present to observe or provide assistance.

[a] This category includes observing user interaction with the biometric capture system through remote sensing, e.g. video surveillance, also known as telepresence.

5.3.3 Risk level

Presence: Optional

Abstract values: Integers 0 to 100

Contents: If present, this data element shall indicate the risk level as a score between 0 and 100, with lower scores being indicative of a lower risk and higher scores being indicative of a higher risk. If the risk level is unknown, then this data element shall not be present.

This field has been left vaguely defined so that system developers may devise their own qualitative or quantitative risk assessment methodologies.

5.3.4 Category of criteria for PAD

Presence: Optional

Abstract values: UNKNOWN, INDIVIDUAL, COMMON

Contents: If present, this data element shall be used to distinguish between PAD decision criteria specific to the individual biometric capture subject and PAD decision criteria common for all biometric capture subjects. Table 3 describes the abstract values of this data element.

Table 3 — Abstract values for categories of criteria for PAD

Abstract value	Description
UNKNOWN	Criteria are unknown.
INDIVIDUAL	Criteria are specific to the individual biometric capture subject.
COMMON	Criteria are global, i.e. common for all biometric capture subjects.

5.3.5 PAD parameters

Presence: Optional

Abstract values: Any printable string

Contents: If present, this data element shall indicate any external parameters, e.g. threshold, employed to make the PAD decision.

5.3.6 PAD challenges

Presence: Optional

Abstract values: One or more printable strings

Contents: If present, this data element shall indicate any challenges that were given to the data capture subject.

5.3.7 PAD data capture date and time

Presence: Optional

Abstract values: 2000-01-01T00:00:00Z to 3000-12-31T23:59:59Z

NOTE The abstract values are given in the extended date-time format of ISO 8601. The character "Z" is the designator for UTC (Coordinated Universal Time).

Contents: If present, this data element shall indicate the date and time when the capture of the PAD data started in UTC (see ISO 8601) to a precision of one second.

5.3.8 Capture device vendor identifier

Presence: Optional

Abstract values: Integers 1 to 65 535

Contents: If present, this data element shall identify the vendor of the capture device. The vendor identifier shall be registered with the Biometric Registration Authority identified in ISO/IEC 19785-1.

5.3.9 Capture device model identifier

Presence: Conditional. This data element shall be included if and only if the capture device vendor identifier is present.

Abstract values: Integers 1 to 65 535

Contents: If present, this data element shall identify the capture device model. The capture device model identifier shall be assigned by the vendor of the capture device.

5.3.10 Capture device serial number

Presence: Optional

Abstract values: Any printable string

Contents: If present, this data element shall identify the capture device.

Annex A
(normative)

Formal specifications

A.1 Tagged binary encoding

A.1.1 General

It is useful to define the data format independently of the bit-level representation (abstract syntax). This enables:

a) different encodings to be used where appropriate;

b) different in-core representations to be used, using structures suited for easy processing with the C, C++ or Java programming languages;

c) a wider range of tools to be used in the implementation of these formats;

d) easier in-core representation on machines that do not have a big-endian hardware architecture;

e) a more easily understood description of the values in the formats.

The abstract syntax for PAD information is specified in A.1.2 in an Abstract Syntax Notation 1 (ASN.1) module conforming to ISO/IEC 8824-1. PAD data in tagged binary format shall be obtained by application of the ASN.1 Distinguished Encoding Rules (DER) (specified by ISO/IEC 8825-1) to values of the types defined in the ASN.1 module in A.1.2. A summary of DER is given in A.1.3. The resulting encoding is shown in A.1.4 in tabular form. In case of conflicts, the ASN.1 module given in A.1.2 takes precedence. The ASN.1 module given in A.1.2 can be retrieved from http://standards.iso.org/iso-iec/30107/-2/ed-1.

Using the abstract syntax as the schema, tools can convert between encodings of values and in-core representations. Tools that convert ASN.1 modules to programming language data structures are called ASN.1 compilers and are supported by run-time routines that convert between an in-core value and specified encodings. Such tools are available on several hardware platforms and for several programming languages and are supplied by multiple vendors.

In order to maintain backward compatibility, i.e. to enable tools based on a new version of the format to read and understand PAD data based on an old version of the format, in new versions, not any element specified in the ASN.1 module given in A.1.2 shall be modified. If new items need to be added to a SET, SEQUENCE or CHOICE in a later version of this document, they shall be added to the end after the extension marker "...". In order to maintain forward compatibility, i.e. to enable tools based on an old version of the format to read PAD data based on a new version of the format, tools reading PAD data shall ignore unknown data elements.

A.1.2 Abstract syntax of the PAD information in ASN.1

The identified ASN.1 module can be retrieved from http://standards.iso.org/iso-iec/30107/-2/ed-1.

```
-- This ASN.1 specification has been checked for conformance with the ASN.1 standard by
-- the OSS ASN.1 Tools.

PADDataFormatModule
{iso standard 30107 data-formats(2) modules(0) pad-data(0) version(0)}
DEFINITIONS
IMPLICIT TAGS            ::=
BEGIN
    PADData              ::= [APPLICATION 98] SET {
```

```
    pADDecision              [0] PADDecision              OPTIONAL,
    pADScoreBlockSequence    [1] PADScoreBlockSequence    OPTIONAL,
    pADExtendedDataSequence  [2] PADExtendedDataSequence  OPTIONAL,
    captureContext           [3] CaptureContext           OPTIONAL,
    supervisionLevel         [4] SupervisionLevel         OPTIONAL,
    riskLevel                [5] RiskLevel                OPTIONAL,
    criteriaCategory         [6] CriteriaCategory         OPTIONAL,
    pADParameter             [7] PADParameter             OPTIONAL,
    pADChallenge             [8] PADChallenge             OPTIONAL,
    pADDataCaptureDateTime   [9] GeneralizedTime          OPTIONAL,
    captureDevice            [10] CaptureDevice           OPTIONAL,
    ...
}

PADDecision             ::= ENUMERATED {
    failure-to-compute(-1),    -- -1, encoded as FF (255)
    no-attack(0),
    attack(1),
    ...
}

PADScoreBlockSequence   ::= SEQUENCE OF PADScoreBlock

PADScoreBlock           ::= SET {
    vendorId                   [0] Id,
    mechanismId                [1] Id,
    pADScore                   [2] PADScore,
    ...
}

Id                      ::= OCTET STRING (SIZE(2))

PADScore                ::= INTEGER {failure-to-compute(-1)} (-1..100, ...)

PADExtendedDataSequence ::= SEQUENCE OF PADExtendedDataBlock

PADExtendedDataBlock    ::= SET {
    vendorId                   [0] Id,
    mechanismId                [1] Id,
    data                       [2] OCTET STRING,
    ...
}

CaptureContext          ::= ENUMERATED {
    enrolment(0),
    verification(1),
    identification(2),
    ...
}

SupervisionLevel        ::= ENUMERATED {
    unknown(0),
    controlled(1),
    assisted(2),
    observed(3),
    unattended(4),
    ...
}

RiskLevel               ::= INTEGER (0..100, ...)

CriteriaCategory        ::= ENUMERATED {
    unknown(0),
    individual(1),
    common(2),
    ...
}

PADParameter            ::= PrintableString

PADChallenge            ::= SEQUENCE OF PrintableString
```

```
    CaptureDevice              ::= SET {
        vendorId                     [0] Id,
        modelId                      [1] Id,
        serialNumber                 [2] PrintableString     OPTIONAL,
    ...
    }
END
```

A.1.3 Summary of the Distinguished Encoding Rules

The DER encoding of a data object has three parts (see ISO/IEC 8825-1).

a) Tag octets: These identify the class and tag number of the data object and indicate whether its type is primitive or constructed. There are two forms.

   1) Low-tag-number form for tag numbers between 0 and 30: The tag octets comprise one octet. Bits 8 and 7 specify the class of the tag (see Table A.1). Bit 6 specifies whether the type is primitive or constructed (bit 6 is set to 0 for primitive types; bit 6 is set to 1 for constructed types). Bits 5 to 1 give the tag number with bit 5 as the most significant bit.

   2) High-tag-number form for tag numbers 31 and greater: The tag octets comprise two or more octets. The first octet is as in the low-tag-number form, except that bits 5 to 1 all are set to 1. Bits 7 to 1 of the second and the following octets give the tag number with bit 7 of the second octet as the most significant bit. Bit 8 of each of the subsequent octets except the last is set to 1.

b) Length octets: These give the number of value octets. There are two forms.

   1) Short form for lengths between 0 and 127: The length octets comprise one octet. Bit 8 has value 0 and bits 7 to 1 give the length.

   2) Long form for lengths between 128 and $21008 - 1$: The length octets comprise two to 127 octets. Bit 8 of the first octet has the value 1 and bits 7 to 1 of the first octet give the number of up to 126 additional length octets with bit 7 as the most significant bit. Bits 8 to 1 of the second and the following octets give the length with bit 8 of the second octet as the most significant bit.

c) Value octets: For values of a primitive type, these give a concrete representation of the value. For values of a constructed type, these give the concatenation of the DER encodings of the components of the value.

Table A.1 — Class encoding in tag octets

Class	Bit 8	Bit 7
Universal	0	0
Application	0	1
Context-specific	1	0
Private	1	1

A.1.4 Tabular description

Table A.2 describes the resulting encoding of PAD data as tag-length-value (TLV) encoded data objects. In Table A.2, the presence of each data element is indicated to be either “mandatory” or "optional". “Mandatory” means that the data element shall be present in its containing data structure. “Optional” means that the data element may be omitted from its containing data structure. Additional conditions may apply.

NOTE All tags except for the top-most tag are context-specific tags, the meanings of which depend on the containing data object.

Table A.2 — Fields for binary PAD data record

Tag	Length	Value							Presence (mandatory or optional)
$7F62_{Hex}$	Variable	PAD data							Optional
		Tag	**Length**	**Value**					
		80_{Hex}	01_{Hex}	PAD decision (see 5.2.1): For encoding, see Table A.3 and Table A.4.					Optional
		$A1_{Hex}$	Variable	Sequence of PAD score blocks: There may be more than one PAD score block.					Optional
				Tag	**Length**	**Value**			
				31_{Hex}	$0B_{Hex}$	PAD score block			Optional
						Tag	**Length**	**Value**	
						80_{Hex}	02_{Hex}	Vendor identifier (see 5.2.2): 0001_{Hex} to $FFFF_{Hex}$	Mandatory (if a PAD score block is present)
						81_{Hex}	02_{Hex}	Mechanism identifier (see 5.2.3): 0001_{Hex} to $FFFF_{Hex}$	Mandatory (if a PAD score block is present)
						82_{Hex}	01_{Hex}	PAD score (see 5.2.4): 01_{Hex} to 64_{Hex}, for encoding of FAILURE_TO_COMPUTE, see Table A.4	Mandatory (if a PAD score block is present)
		$A2_{Hex}$	Variable	Sequence of PAD extended data blocks: There may be multiple PAD extended data blocks generated with different mechanisms.					Optional
				Tag	**Length**	**Value**			
				31_{Hex}	Variable	PAD extended data block			Optional
						Tag	**Length**	**Value**	
						80_{Hex}	02_{Hex}	Vendor identifier (see 5.2.5): 0001_{Hex} to $FFFF_{Hex}$	Mandatory (if a PAD extended data block is present)
						81_{Hex}	02_{Hex}	Mechanism identifier (see 5.2.6): 0001_{Hex} to $FFFF_{Hex}$	Mandatory (if a PAD extended data block is present)
						82_{Hex}	Variable	PAD extended data (see 5.2.7)	Mandatory (if a PAD extended data block is present)
		83_{Hex}	01_{Hex}	Context of capture (see 5.3.1): For encoding, see Table A.5.					Optional
		84_{Hex}	01_{Hex}	Level of supervision/surveillance during the capture process (see 5.3.2): For encoding, see Table A.6					Optional
		85_{Hex}	01_{Hex}	Risk level (see 5.3.3): 01_{Hex} to 64_{Hex}					Optional
		86_{Hex}	01_{Hex}	Category of criteria for PAD (see 5.3.4): For encoding, see Table A.7					Optional
		87_{Hex}	Variable	PAD parameters (see 5.3.5): Printable string					Optional

Table A.2 *(continued)*

Tag	Length	Value					Presence (mandatory or optional)
		$A8_{Hex}$	Variable	Sequence of PAD challenges: There may be more than one PAD challenge.			Optional
				Tag	**Length**	**Value**	
				13_{Hex}	Variable	PAD challenge (see 5.3.6): Printable string	Optional
		89_{Hex}	$0F_{Hex}$	PAD data capture date and time (see 5.3.7): The value shall consist of the following in the given order: — Four bytes containing the UTF-8 encoding of the four-digit representation of the calendar year, — Two bytes containing the UTF-8 encoding of the two-digit representation of a calendar month (01 to 12), — Two bytes containing the UTF-8 encoding of the two-digit representation of a calendar day of month (01 to 31), — Two bytes containing the UTF-8 encoding of the two-digit representation of an hour on the given date (00 to 23), — Two bytes containing the UTF-8 encoding of the two-digit representation of a minute within the hour (00 to 59), — Two bytes containing the UTF-8 encoding of the two-digit representation of a second within the minute (00 to 59), and — One byte containing the UTF-8 encoding of the upper-case letter Z designating UTC ($5A_{Hex}$). EXAMPLE December 15, 2005, 17:35:20 is encoded as 32303035 3132 3135 3137 3335 3230 $5A_{Hex}$.			Optional
		AA_{Hex}	Variable	Capture device data: Only one capture device is used per presentation.			Optional
				Tag	**Length**	**Value**	
				80_{Hex}	02_{Hex}	Vendor identifier (see 5.3.8): 0001_{Hex} to $FFFF_{Hex}$	Mandatory (if capture device data is present)
				81_{Hex}	02_{Hex}	Model identifier (see 5.3.9): 0001_{Hex} to $FFFF_{Hex}$	Mandatory (if capture device data is present)
				82_{Hex}	Variable	Serial number (see 5.3.10): Printable string	Optional

Table A.3 — Encoding of PAD decision

Abstract value	Encoding
NO_ATTACK	00_{Hex}
ATTACK	01_{Hex}

Table A.4 — Encoding of the abstract value FAILURE_TO_COMPUTE

Abstract value	Encoding
FAILURE_TO_COMPUTE	FF_{Hex}

Table A.5 — Encoding of context of capture

Abstract value	Encoding
ENROLMENT	00_{Hex}
VERIFICATION	01_{Hex}
IDENTIFICATION	02_{Hex}

Table A.6 — Encoding of level of supervision/surveillance

Abstract value	Encoding
UNKNOWN	00_{Hex}
CONTROLLED	01_{Hex}
ASSISTED	02_{Hex}
OBSERVED	03_{Hex}
UNATTENDED	04_{Hex}

Table A.7 — Encoding of category of criteria for PAD

Abstract value	Encoding
UNKNOWN	00_{Hex}
INDIVIDUAL	01_{Hex}
COMMON	02_{Hex}

A.2 XML encoding

A.2.1 General

A.2.2 defines the syntax for PAD data elements in XML documents in terms of an XML schema. The XML schema definition in A.2.2 follows best practices for writing XML schemas.

The syntax of PAD data elements in XML documents shall be based on the XML schema definition in A.2.2, not on the ASN.1 module in A.1.2 and the ASN.1 XML Encoding Rules (XER) specified by ISO/IEC 8825-4.

NOTE There is no standard for mapping an ASN.1 module to an XML schema. Application of XER specified by ISO/IEC 8825-4 to ASN.1 abstract values directly yields XML documents, which, however, deviate from XML documents based on the XML schema defined in A.2.2.

A.2.2 XML schema definition

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Permission is hereby granted, free of charge in perpetuity, to any person obtaining
a copy of the Schema, to use, copy, modify, merge and distribute free of charge, copies
of the Schema for the purposes of developing, implementing, installing and using software
based on the Schema, and to permit persons to whom the Schema is furnished to do so,
subject to the following conditions:
THE SCHEMA IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED,
INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR
PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE
FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR
OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SCHEMA OR THE USE OR OTHER
DEALINGS IN THE SCHEMA. In addition, any modified copy of the Schema shall include the
following notice: THIS SCHEMA HAS BEEN MODIFIED FROM THE SCHEMA DEFINED IN ISO/IEC 30107-
2, AND SHOULD NOT BE INTERPRETED AS COMPLYING WITH THAT STANDARD-->

<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
      xmlns="http://standards.iso.org/iso-iec/30107/-2/ed-1"
      targetNamespace="http://standards.iso.org/iso-iec/30107/-2/ed-1"
      elementFormDefault="qualified"
      attributeFormDefault="unqualified">
```