BS ISO/IEC 19794-7:2021

BSI Standards Publication

Information technology - Biometric data interchange formats

Part 7: Signature/sign time series data

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National foreword

This British Standard is the UK implementation of ISO/IEC 19794-7:2021. It supersedes BS ISO/IEC 19794-7:2014+A1:2015, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee IST/44/-/3, Biometric data interchange formats.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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ISO/IEC 19794-7

Third edition
2021-10

Information technology — Biometric data interchange formats —

Part 7: Signature/sign time series data

Technologies de l'information — Formats d'échange de données biométriques —

Partie 7: Données de série chronologique de signature/signe

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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 document 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 or www.iec.ch/members_experts/refdocs).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC 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) or the IEC list of patent declarations received (see patents.iec.ch).

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

For an explanation of 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 www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

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

This third edition cancels and replaces the second edition (ISO/IEC 19794-7:2014), which has been technically revised. It also incorporates the Amendment ISO/IEC 19794-7:2014/Amd 1:2015.

The main changes are as follows:

— inclusion of ISO/IEC 19794-7:2014/Amd 1:2015, *XML encoding*, and correction of technical defects therein.

A list of all parts in the ISO/IEC 19794 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

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Information technology — Biometric data interchange formats —

Part 7: Signature/sign time series data

1 Scope

This document specifies data interchange formats for signature/sign behavioural data captured in the form of a multi-dimensional time series using devices such as digitizing tablets or advanced pen systems. The data interchange formats are generic, in that they can be applied and used in a wide range of application areas where handwritten signs or signatures are involved. No application-specific requirements or features are addressed in this document.

This document contains:

— a description of what data can be captured;

— three binary data formats for containing the data: a full format for general use, a compression format capable of holding the same amount of information as the full format but in compressed form, and a compact format for use with smart cards and other tokens that does not require compression/decompression but conveys less information than the full format;

— an XML schema definition; and

— examples of data record contents and best practices in capture.

Specifying which of the format types and which options defined in this document are to be applied in a particular application is out of scope; this needs to be defined in application-specific requirements specifications or application profiles.

It is advisable that cryptographic techniques be used to protect the authenticity, integrity, and confidentiality of stored and transmitted biometric data; yet such provisions are beyond the scope of this document.

This document also specifies elements of conformance testing methodology, test assertions and test procedures as applicable to this document. It establishes test assertions on the structure and internal consistency of the signature/sign time series data formats defined in this document (type A level 1 and 2 as defined in ISO/IEC 19794-1) and semantic test assertions (type A level 3 as defined in ISO/IEC 19794-1).

The conformance testing methodology specified in this document does not establish:

— tests of other characteristics of biometric products or other types of testing of biometric products (e.g. acceptance, performance, robustness, security); or

— tests of conformance of systems that do not produce data records claimed to conform to the requirements of this document.

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.

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

ISO/IEC 19794-1, *Information technology — Biometric data interchange formats — Part 1: Framework*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19794-1 and the following 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
channel
data item (captured, intermediate, or processed) recorded in form of a time series

EXAMPLE Pen tip position *x* and *y* coordinates, pen tip force, *pen tilt along the x-axis* (3.7), *pen tilt along the y-axis* (3.8), *pen azimuth* (3.3), *pen elevation* (3.5), *pen rotation* (3.6).

3.2
compression
process that reduces the size of a digital file with or without loss of information

Note 1 to entry: The compression format defined in Clause 10 includes data compressed by lossless compression schemes.

3.3
pen azimuth
angle measured clockwise from the positive *y*-axis to the perpendicular projection of the pen onto the writing plane

Note 1 to entry: The pen azimuth may range from 0° to 360°.

3.4
pen-down event
event from which on the pen tip is touching the writing plane

3.5
pen elevation
angle between the perpendicular projection of the pen onto the writing plane and the pen

Note 1 to entry: The pen elevation may range from 0° to 90°.

3.6
pen rotation
angle of the rotation of the pen about its longitudinal axis measured counter-clockwise from a device-specific rotational reference position

Note 1 to entry: The pen rotation may range from 0° to 360°.

3.7
pen tilt along the *x*-axis
angle measured clockwise from the positive *z*-axis to the perpendicular projection of the pen onto the *xz* plane

Note 1 to entry: The pen tilt along the *x*-axis may range from –90° to +90°.

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3.8
pen tilt along the *y*-axis
angle measured clockwise from the positive *z*-axis to the perpendicular projection of the pen onto the *yz* plane

Note 1 to entry: The pen tilt along the *y*-axis may range from –90° to +90°.

3.9
pen-up event
event from which on the pen tip is not touching the writing plane, after a *pen-down event* (3.4)

3.10
sampling rate
number of samples per second (or per another unit) taken from a continuous signal to make a discrete signal

3.11
signature/sign representation
data recorded from a single signature/sign

3.12
***x* jitter**
sample standard deviation of at least 100 *x*-coordinate samples from a stationary pen

3.13
***y* jitter**
sample standard deviation of at least 100 *y*-coordinate samples from a stationary pen

3.14
***x* pixel density**
number of dots per millimetre that the capture device resolves in the *x* (horizontal) direction

3.15
***y* pixel density**
number of dots per millimetre that the capture device resolves in the *y* (vertical) direction

4 Abbreviated terms

ASCII	American Standard Code for Information Interchange
BDB	biometric data block
BDIR	biometric data interchange record
BHT	biometric header template
BIR	biometric information record
BIT	biometric information template
CBEFF	Common Biometric Exchange Formats Framework
IBIA	International Biometrics & Identification Association
ICS	implementation conformance statement
lsb	least significant bit
msb	most significant bit

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5 Conformance

A binary biometric data record conforms to this document if it satisfies the format requirements with respect to its structure, with respect to relations among its fields, and with respect to relations between its fields and the underlying input that are specified within Clauses 6 to 10 of this document.

An XML document conforms to this document if it satisfies the format requirements with respect to its structure, relations among its fields, and relations between its fields and the underlying input that are specified within Annex E.

Biometric data interchange format conformance tests conform to this document if they satisfy all of the normative requirements set forth in Annex A. Specifically, all level-1, level-2, and level-3 tests shall use the test assertions defined in Table A.2, Table A.3, and Table A.4 of this document in conformity with the concept and rules set out in ISO/IEC 19794-1.

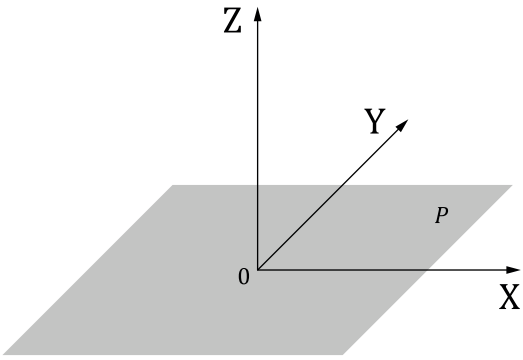
Implementations of this document tested according to the specified methodology shall be able to claim conformance only to those biometric data record requirements specified in this document that are tested by the test methods established by this methodology.

Implementations of this document are not necessarily required to conform to all possible aspects of this document, but only to those requirements that are claimed to be supported by the implementation in an implementation conformance statement (ICS), filled out in accordance with ISO/IEC 19794-1 and Table A.1 of this document.

6 Conventions

6.1 Coordinate system

The coordinate system used to express the pen position shall be a three-dimensional Cartesian coordinate system. The *x*-axis shall be the horizontal axis of the writing plane, with *x*-coordinates increasing to the right. The *y*-axis shall be the vertical axis of the writing plane, with *y*-coordinates increasing upwards. The *z*-axis shall be the axis perpendicular to the writing plane, with *z*-coordinates increasing upwards out of the writing plane starting from 0. For an illustration see Figure 1.



Key

P writing plane

Figure 1 — Coordinate system

NOTE The origin of *x* and *y*-coordinates is not specified here. Depending on the used technology, it can be, for instance, in the centre of the writing pad, at its lower left corner, or at the pen position at the first pen-down event.

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6.2 Octet and bit order

The more significant bytes of any multi-byte quantity are stored at lower addresses in memory than (and are transmitted before) less significant bytes.

Within a byte, the bits are numbered from 8 to 1, where bit 8 is the 'most significant bit' (msb) and bit 1 the 'least significant bit' (lsb).

6.3 Registered format type identifiers

The data records specified in this document may be embedded in a CBEFF-compliant biometric information record (BIR) (see ISO/IEC 19785-1). This subclause lists the BDB (biometric data block) format owner identifier and the BDB format type identifiers that shall be used if embedded in a CBEFF BIR. These identifiers are registered with IBIA, the CBEFF Registration authority (see ISO/IEC 19785-2).

The format owner of the formats defined in the ISO/IEC 19794 series is ISO/IEC JTC 1/SC 37. The format owner identifier is 257 (0101_{Hex}). Table 1 lists the format type identifiers for the formats defined in this document.

Table 1 — Format type identifiers

CBEFF BDB format type identifier	Short name	Full object identifier
14 ($000e_{Hex}$)	signature-sign-time-series-full	{iso(1) registration-authority(1) cbeff(19785) biometric-organization(0) jtc1-sc37(257) bdbs(0) signature-sign-time-series-full(14)}
15 ($000f_{Hex}$)	signature-sign-time-series-compact	{iso(1) registration-authority(1) cbeff(19785) biometric-organization(0) jtc1-sc37(257) bdbs(0) signature-sign-time-series-compact(15)}
30 ($001e_{Hex}$)	signature-sign-time-series-compression	{iso(1) registration-authority(1) cbeff(19785) biometric-organization(0) jtc1-sc37(257) bdbs(0) signature-sign-time-series-compression(30)}
38 (0026_{Hex})	XML-signature-sign-time-series	{iso(1) registration-authority(1) cbeff(19785) biometric-organization(0) jtc1-sc37(257) bdbs(0) XML-signature-sign-time-series(38)}

NOTE 1 The format type identifier for the full format defined in this document (ISO/IEC 19794-7:2021) is the same as the one for the full format defined in ISO/IEC 19794-7:2007. An indication of which version of the full format applies can be determined from the version number included in the general header.

NOTE 2 The compact format defined in this document (ISO/IEC 19794-7:2021) is the same as the one defined in ISO/IEC 19794-7:2007. Hence, the format type identifier for the compact format defined in this edition of ISO/IEC 19794-7 is also the same as the one for the compact format defined in ISO/IEC 19794-7:2007.

7 Channels

7.1 General

Table 2 lists the channel names and their meanings. Signature/sign time series data captured with different capture devices or used in different applications may contain data from different channels. Either the T channel or the DT channel shall be present, or uniform sampling (constant time difference between adjacent sample points) shall be indicated (see 7.6). Inclusion of at least one other channel is mandatory.

Annex B provides recommendations for ensuring the quality of signature/sign time series data.

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Table 2 — Channels

Channel name	Description
X	*x*-coordinate (horizontal pen position)
Y	*y*-coordinate (vertical pen position)
Z	*z*-coordinate (height of pen above the writing plane)
VX	velocity in *x*-direction
VY	velocity in *y*-direction
AX	acceleration in *x*-direction
AY	acceleration in *y*-direction
T	time
DT	time difference
F	pen tip force
S	pen tip switch state (touching/not touching the writing plane)
TX	pen tilt along the *x*-axis
TY	pen tilt along the *y*-axis
A	pen azimuth
E	pen elevation
R	pen rotation

7.2 Pen tip position channels: X, Y, Z

There are three channels defined for recording pen tip position data in the three-dimensional space. The X channel is for recording the *x*-coordinate of the projection of the pen tip on the writing plane. The Y channel is for recording the *y*-coordinate of the projection of the pen tip on the writing plane. The Z channel is for recording the height of the pen tip above the writing plane.

The unit of measurement is millimetres (mm). To restore the actual values, the integer values given in the record body are to be divided by a scaling value given in the channel description. By choosing appropriate scaling values, different degrees of accuracy can be expressed.

7.3 Pen tip velocity channels: VX, VY

The VX channel is for recording the pen tip velocity along the *x*-axis. The VY channel is for recording the pen tip velocity along the *y*-axis.

The unit of measurement is millimetres per second (mm/s). To restore the actual values, the integer values given in the record body are to be divided by a scaling value given in the channel description. By choosing appropriate scaling values, different degrees of accuracy can be expressed.

7.4 Pen tip acceleration channels: AX, AY

The AX channel is for recording the pen tip acceleration along the *x*-axis. The AY channel is for recording the pen tip acceleration along the *y*-axis.

The unit of measurement is millimetres per square second (mm/s^2). To restore the actual values, the integer values given in the record body are to be divided by a scaling value given in the channel description. By choosing appropriate scaling values, different degrees of accuracy can be expressed.

7.5 Time channel: T

The T channel is for recording the time elapsed since the first sample.

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The unit of measurement is seconds (s). To restore the actual values, the integer values given in the record body are to be divided by a scaling value given in the channel description. By choosing appropriate scaling values, different degrees of accuracy can be expressed.

7.6 Time difference channel: DT

The DT channel is for recording the time elapsed since the previous sample point.

The unit of measurement is seconds (s). To restore the actual values, the integer values given in the record body are to be divided by a scaling value given in the channel description. By choosing appropriate scaling values, different degrees of accuracy can be expressed.

In case of uniform sampling, the channel inclusion field (see 8.3.2.8.1) in the representation header should indicate the DT channel as present, but the DT channel values should be absent in the representation body while the channel description preamble (see 8.3.2.8.2) for the DT channel indicates the time differences between adjacent sample points as constant.

7.7 Pen tip force channel: F

The F channel is for recording the magnitude of the pen tip force.

The unit of measurement is Newton (N). To restore the actual values, the integer values given in the record body are to be divided by a scaling value given in the channel description. By choosing appropriate scaling values, different degrees of accuracy can be expressed.

NOTE The direction of the pen-tip force depends on the capture device technology, which is identified by the capture device technology identifier.

7.8 Pen tip switch state channel: S

The S channel is for recording whether the pen tip touches the writing plane or not. The value shall be 0 in the case that the pen tip does not touch the writing plane. In case of pen-down events, the value shall also be 0. The value shall be 1 in the case that the pen tip touches the writing plane. In case of pen-up events, the value shall also be 1.

NOTE Temporarily maintaining a value of 0 when the pen tip starts touching the writing plane allows a recognition of pen-down events even if the capture device provides no sample points for pen-up strokes.

7.9 Pen orientation channels: TX, TY, A, E, R

There are five channels defined for recording pen orientation data. The A channel is for recording the pen azimuth. The E channel is for recording the pen elevation. The TX channel is for recording the pen tilt along the *x*-axis. The TY channel is for recording the pen tilt along the *y*-axis. The R channel is for recording the rotation of the pen about its longitudinal axis. It may be chosen to use:

— pen azimuth and pen elevation, or

— pen tilt along the *x* and *y*-axes,

with or without the pen rotation. For illustrations see Figure 2 and Figure 3.

The unit of measurement for the pen orientation angles is degree (°). To restore the actual values, the integer values given in the record body are to be divided by a scaling value given in the channel description. By choosing appropriate scaling values, different degrees of accuracy can be expressed.

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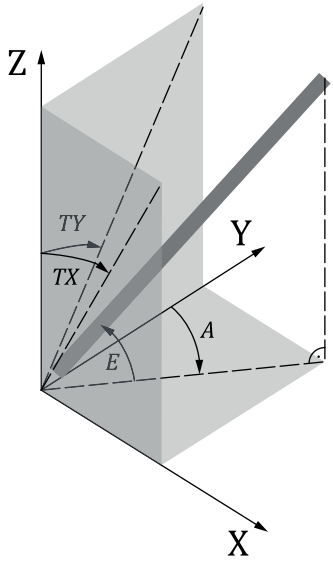


Key

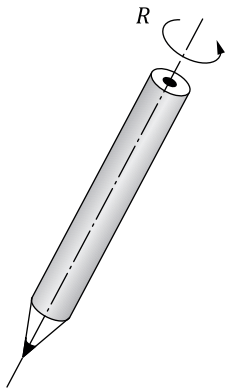
A pen azimuth

E pen elevation

TX pen tilt along the *x*-axis

TY pen tilt along the *y*-axis

Figure 2 — Pen orientation angles



Key

R rotation of the pen about its longitudinal axis

Figure 3 — Pen rotation

8 Binary full format

8.1 Record organization

A signature/sign time series data record in the full format shall consist of the following data elements in the given order:

— a general header, containing descriptive information about the structure and contents of the data record, and

— a record body, containing at least one signature/sign representation.

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Figure 4 depicts a signature/sign time series data record in full format. The solid boxes indicate fields that shall be present. The dashed boxes indicate optional fields. The length of each field in bytes is indicated in parentheses at the bottom of the corresponding box. The ellipses indicate that more fields of the same format may follow.

D.1 contains an encoding example in binary full format.

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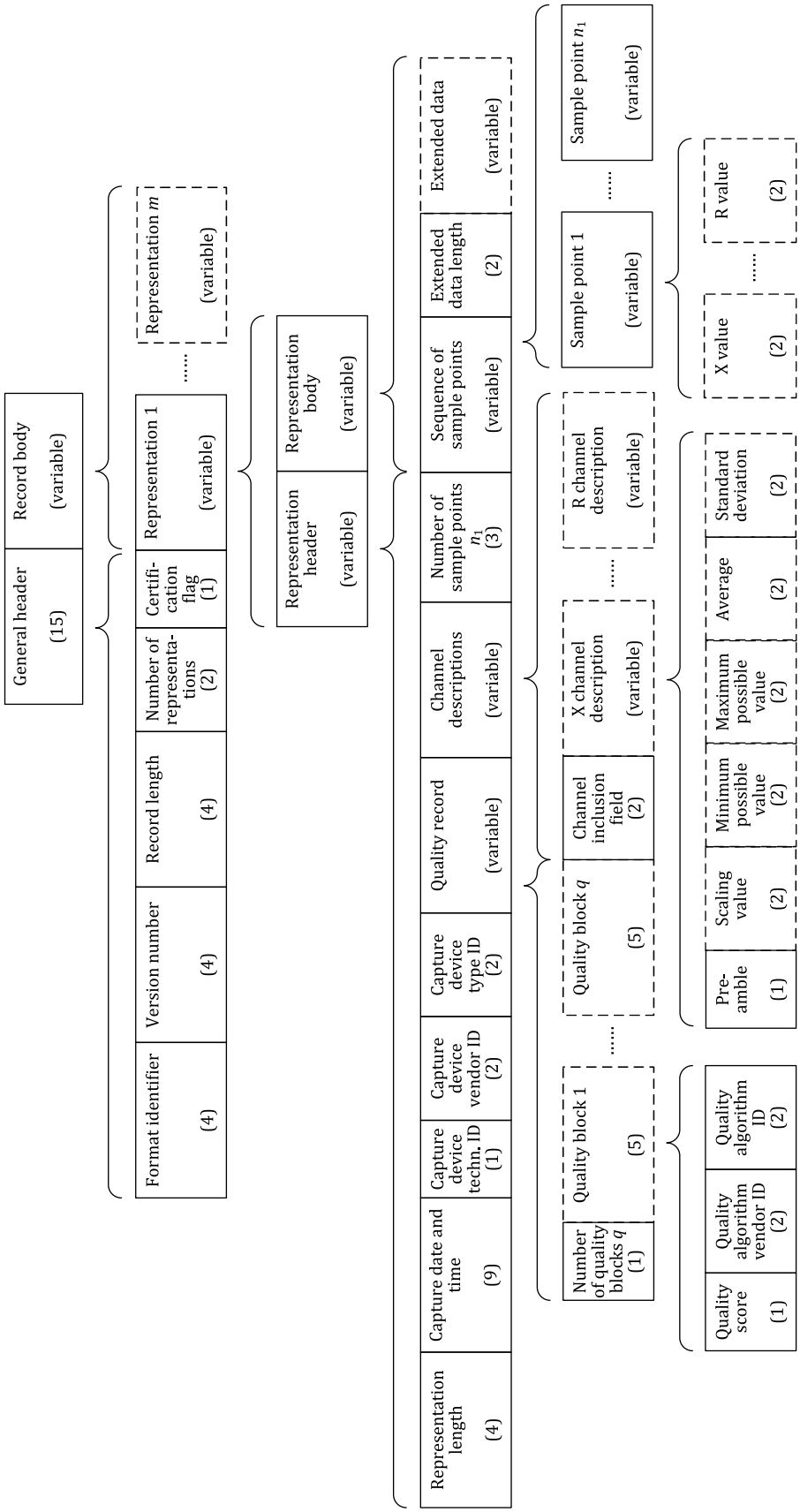

Figure 4 — Binary full format

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8.2 General header

8.2.1 Structure

The general header shall contain information applicable to all signature/sign representations. The general header shall consist of the following data elements in the given order:

— a format identifier,

— a version number,

— the length of the data record,

— a field indicating the number of subsequent signature/sign representations, and

— a certification flag.

8.2.2 Format identifier

The format identifier shall be recorded in four bytes. The format identifier shall consist of the three ASCII characters "SDI" (534449_{Hex}) followed by Null (00_{Hex}) as a string terminator.

8.2.3 Version number

The number of the version of this document shall be placed in four bytes. This version number shall consist of three ASCII characters followed by Null (00_{Hex}) as a string terminator. The first and second characters represent the major revision number and the third character represents the minor revision number.

In a signature/sign time series data record following the second edition of this document, the version number shall be 3032 3000_{Hex}, i.e. "020" (an ASCII '0' followed by an ASCII '2' and an ASCII '0') followed by Null (00_{Hex}) as a string terminator.

In a signature/sign time series data record following this third edition of this document, the version number shall be 3032 3100_{Hex}, i.e. "021" (an ASCII '0' followed by an ASCII '2' and an ASCII '1') followed by Null (00_{Hex}) as a string terminator.

8.2.4 Length of the data record

The length in bytes of the entire BDIR (biometric data interchange record) shall be recorded in four bytes. This count shall be the total length of the BDIR including the general header and one or more representation records.

8.2.5 Number of representations

The total number of representation records contained in the BDIR shall be recorded in two bytes. A minimum of one representation is required.

8.2.6 Certification flag

The one-byte certification flag indicates whether each representation header includes a certification record. Its value shall be 00_{Hex} to indicate that no representation contains a certification record.

NOTE The certification flag has been added for upward compatibility with later versions of the full format in which representation headers can contain certification records.

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8.3 Record body

8.3.1 Structure

The record body shall consist of a sequence of at least one signature/sign representation. Each signature/sign representation shall consist of the following data elements in the given order:

— a representation header, and

— a representation body.

8.3.2 Representation header

8.3.2.1 Structure

A signature/sign representation header shall contain representation-specific descriptive information. A representation header shall consist of the following data elements in the given order:

— a representation-length field,

— the capture date and time,

— a capture device technology identifier,

— a capture device vendor identifier,

— a capture device type identifier,

— a quality record,

— a sequence of channel descriptions, and

— a field indicating the number of sample points.

8.3.2.2 Length of the signature/sign representation

The four-byte representation-length field denotes the length in bytes of the representation including the representation header.

8.3.2.3 Capture date and time

The capture date and time field shall indicate when the capture of this representation started in Coordinated Universal Time (UTC). The capture date and time field shall consist of 9 bytes. Its value shall be encoded in the form given in ISO/IEC 19794-1.

8.3.2.4 Capture device technology identifier

The capture device technology ID shall be encoded in one byte. This field shall indicate the class of capture device technology used to acquire the captured biometric sample. A value of 00_{Hex} indicates unknown or unspecified technology. See Table 3 for the list of possible values.

Table 3 — Signature/sign capture device technology identifiers

Identifier	Capture device technology
00_{Hex}	Unknown or unspecified
01_{Hex}	Electromagnetic
02_{Hex}	Semiconductor
04_{Hex}	Special pen with acceleration sensors

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Table 3 *(continued)*

Identifier	Capture device technology
08_{Hex}	Special pen with optical sensors
all others	Reserved by ISO/IEC JTC 1/SC 37 for future use

8.3.2.5 Capture device vendor identifier

The capture device vendor identifier shall identify the biometric organization that owns the product that created the BDIR. The capture device vendor identifier shall be encoded in two bytes carrying a CBEFF biometric organization identifier (registered by IBIA or other approved registration authority). A value of all zeros shall indicate that the capture device vendor is unreported.

8.3.2.6 Capture device type identifier

The capture device type identifier shall identify the product type that created the BDIR. It shall be assigned by the registered product owner or other approved registration authority. Registered product types shall include all valid combinations of writing tablet and pen as a single product where applicable. A value of all zeros shall indicate that the capture device type is unreported. If the capture device vendor identifier is 0000_{Hex}, then also the capture device type identifier shall be 0000_{Hex}.

8.3.2.7 Quality record

The quality record shall consist of a length field followed by zero or more quality blocks. The length field shall consist of one byte. It shall represent the number of quality blocks as an unsigned integer.

Each quality block shall consist of:

— a quality score,

— a quality algorithm vendor identifier, and

— a quality algorithm identifier.

A quality score should express the predicted comparison performance of a representation. A quality score shall be encoded in one byte as an unsigned integer. Allowed values are:

— 0 to 100 with higher values indicating better quality,

— 255, i.e. ff_{Hex}, for indicating that an attempt to calculate a quality score failed.

The quality algorithm vendor identifier shall identify the provider of the quality algorithm. The quality algorithm vendor identifier shall be encoded in two bytes carrying a CBEFF biometric organization identifier (registered by IBIA or other approved registration authority). A value of all zeros shall indicate that the quality algorithm vendor is unreported.

The quality algorithm identifier shall identify the vendor's quality algorithm that created the quality score. It shall be assigned by the provider of the quality algorithm or an approved registration authority. The quality algorithm identifier shall be encoded in two bytes. A value of all zeros shall indicate that the quality algorithm is unreported.

8.3.2.8 Channel descriptions

8.3.2.8.1 Channel inclusion field

The channel descriptions field shall begin with a channel inclusion field indicating the presence or absence of channels.

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The channel inclusion field shall consist of two bytes. Each bit shall correspond to a channel as shown in Table 4. A bit value of 1 shall encode the presence of the corresponding channel; a bit value of 0 shall encode the absence of the corresponding channel.

Table 4 — Format of the channel inclusion field

Channel name	Octet	Bit position
X	1	8 (msb)
Y		7
Z		6
VX		5
VY		4
AX		3
AY		2
T		1 (lsb)
DT	2	8 (msb)
F		7
S		6
TX		5
TY		4
A		3
E		2
R		1 (lsb)

The channel inclusion field shall be followed by a sequence of channel descriptions for the channels indicated as present in the channel inclusion field. The order of the channel descriptions is determined by the order of indicated inclusion within the channel inclusion field starting with the X channel. The channel descriptions are mandatory for all channels present in the signature/sign time series data record.

EXAMPLE Figure 5 shows the channel inclusion field for signature/sign time series data including the channels X, Y, T, F, S, A, E and R.

Octet 1								Octet 2							
1	1	0	0	0	0	0	1	0	1	1	0	0	1	1	1

Figure 5 — Example of a channel inclusion field

8.3.2.8.2 Channel description preamble

Each channel description shall begin with a preamble. Each channel description preamble shall consist of one byte.

Each of the bits 4 through 8 of a channel description preamble shall correspond to a channel attribute as shown in Table 5. A bit value of 1 shall encode the presence of the corresponding channel attribute; a bit value of 0 shall encode the absence of the corresponding channel attribute. If any of the bits 4 through 8 of a channel description preamble are set to 1, the preamble shall be followed by a sequence of channel attributes in the same order as indicated in the preamble starting with the scaling value.

Table 5 — Format of a channel description preamble

Channel attribute	Bit position
Scaling value	8 (msb)

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Table 5 *(continued)*

Channel attribute	Bit position
Minimum possible channel value	7
Maximum possible channel value	6
Average of the channel values	5
Standard deviation of the channel values	4
Constant value	3
Removal of the linear component with respect to time	2
Reserved by ISO/IEC JTC 1/SC 37 for future use	1 (lsb)

A value of 1 for bit 3 of a channel description preamble shall indicate that the value of this channel is constant. If bit 3 of a channel description preamble is set to 1, then this channel shall be absent in the representation body even though the representation header indicates the presence of the channel. If the channel description contains a scaling value, then the constant value of this channel shall be 1 divided by the scaling value.

EXAMPLE 1 Bit 3 of the DT channel description preamble can be used to indicate a uniform sampling rate.

NOTE 1 For all other channels except the DT channel, bit 3 of the channel description preamble is usually 0.

A value of 1 for bit 2 of a channel description preamble shall indicate that the linear component of the regression line for this channel has been removed from this channel.

EXAMPLE 2 Bit 2 of the X channel description preamble can be used to indicate that the linear component of the X-on-T regression line (which can be present due to writing along a horizontal line) has been removed from the X channel in order to map the X values to a smaller range.

NOTE 2 Since the removal of a linear trend with respect to time is not practically relevant for the time channel, the value of 1 should not be used for bit 2 of the channel description preamble of the T channel.

The unused trailing bit of the preamble shall have value 0 and is reserved by ISO/IEC JTC 1/SC 37 for future use.

8.3.2.8.3 Scaling value

If present, scaling values shall consist of two bytes. The five most significant bits of the first byte shall constitute the exponent field, *E*, and the remaining eleven bits shall constitute the fraction field, *F*.

The exponent field, *E*, contains an unsigned integer representing the base 2 exponent of the scaling value biased by 16. For the exponent, signed integer values in the range from –16 to 15 are possible. For encoding the exponent value, 16 is to be added in order to get an unsigned value. For decoding the exponent value, 16 is to be subtracted from the contents of *E*.

The fraction field, *F*, contains the bit field that lies, in binary notation, to the right of the leading bit and the binary point of the scaling value's coefficient lying in the range 1 ≤ coefficient < 2.

The scaling value, *s*, is calculated using Formula (1):

$$s = \left(1 + \frac{F}{2^{11}}\right) \cdot 2^{E-16} \tag{1}$$

EXAMPLE $s = 1$ is represented by a value of 00_{Hex} in the fraction field, *F*, and a value of 10_{Hex} in the exponent field, *E*.

The scaling value has a range from 2^{-16} to $\left(1 + \frac{2047}{2048}\right) \cdot 2^{15}$, i.e. from 0,000 015 258 789 062 5 to 65 520.

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The channel values in the representation body as well as the minimum, maximum, and average channel values and the standard deviation in the representation header are to be divided by the corresponding scaling value to obtain their actual values.

If the scaling value is absent, the calibration of the corresponding channel is unknown.

8.3.2.8.4 Minimum and maximum possible channel values

If present, the minimum and maximum possible channel values shall indicate the scaled range of values that the deployed capture device may deliver for the corresponding channel.

For the minimum and maximum possible channel values of the Z, T, DT, F, A, E and R channels, integer values in the range from 0 to 65 535 are allowed. These values shall be encoded in two bytes as unsigned integers.

For the minimum and maximum possible channel values of the X, Y, VX, VY, AX, AY, TX, and TY channels, integer values in the range from –32 768 to 32 767 are allowed. These values shall be encoded in two bytes as unsigned integers after adding 32 768 to each value. Hence, for non-negative numbers, bit 8 of the most significant byte has the value 1; for negative numbers, bit 8 of the most significant byte has the value 0. For decoding these values, 32 768 is to be subtracted from each recorded value.

8.3.2.8.5 Average and standard deviation of the channel values

If present, the average of the channel values shall be the arithmetic mean $\bar{c}$, rounded to the nearest integer, of all values c_i ($1 \le i \le N$ where N is the number of sample points) for the corresponding channel within a signature/sign time series data record, according to Formula (2):

$$\bar{c} = \frac{1}{N}\sum_{i=1}^{N} c_i \tag{2}$$

If present, the standard deviation of the channel values shall be the empirical standard deviation σ_c, rounded to the nearest integer, of all values c_i ($1 \le i \le N$) for the corresponding channel within a signature/sign time series data record, according to Formula (3):

$$\sigma_c = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(c_i - \bar{c})^2} \tag{3}$$

For the averages of the Z, T, DT, F, A, E and R channels, as well as for the standard deviations of all channels, integer values in the range from 0 to 65 535 are allowed. These values shall be encoded in two bytes as unsigned integers.

For the averages of the X, Y, VX, VY, AX, AY, TX and TY channels, integer values in the range from 32 768 to 32 767 are allowed. These values shall be encoded in two bytes as unsigned integers after adding 32 768 to each value. Hence, for non-negative numbers, bit 8 of the most significant byte has the value 1; for negative numbers, bit 8 of the most significant byte has the value 0. For decoding these values, 32 768 is to be subtracted from each recorded value.

NOTE The average and the standard deviation values provide information as to whether and to which range the signature/sign data has been transformed for facilitating comparison.

EXAMPLE The averages of the X and Y channels provide information as to whether the signature/sign data has been translated and rotated for facilitating comparison. If present, the standard deviation values of the X and Y channels provide information about the range to which the signature/sign data has been normalized and scaled for facilitating comparison.

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8.3.2.9 Number of sample points

The length field shall indicate the number of sample points. The length field shall consist of three bytes, representing the number of sample points as an unsigned integer.

8.3.3 Representation body

8.3.3.1 Structure

A signature/sign representation body shall consist of:

— a sequence of sample point fields, each consisting of a sequence of channel values, and

— an extended data length field followed by optional extended data.

8.3.3.2 Sequence of sample points

Each sample point field shall consist of a sequence of selected channel values as indicated by the channel inclusion field in the representation header. The order of the channel values is determined by the order of indicated inclusion within the channel inclusion field (Table 4).

For the Z, T, DT, F, A, E, and R channels, integer values in the range from 0 to 65 535 are allowed. These values shall be encoded in two bytes as unsigned integers.

For the X, Y, VX, VY, AX, AY, TX, and TY channels, integer values in the range from –32 768 to 32 767 are allowed. These values shall be encoded in two bytes as unsigned integers, after adding 32 768 to each value. Hence, for non-negative numbers, bit 8 of the most significant byte has the value 1; for negative numbers, bit 8 of the most significant byte has the value 0. For decoding these values, 32 768 is to be subtracted from each recorded value.

For the S channel, the integer values 0 and 1 are allowed. These values shall be encoded in one byte as unsigned integers.

8.3.3.3 Extended data length

The extended data length field shall indicate the number of bytes in the extended data field. The length field shall consist of two bytes, representing the number of subsequent bytes as an unsigned integer. Values in the range from 0 to 65 535 are allowed.

8.3.3.4 Extended data

The optional extended data field allows for inclusion of additional data that may be used by comparison algorithms. The structure of the extended data field is not prescribed by this document. If extended data is present and the comparison algorithm does not recognize its format, the algorithm shall ignore it.

NOTE Comparison algorithms claiming to use data records conforming to the full format defined in this document should be capable of achieving equivalent biometric performance in terms of error rates when processing data records without extended data and when processing data records with extended data.

9 Binary compact format

9.1 Record organization

The compact format of signature/sign time series data is for use with smart cards and other tokens. Its areas of application include both off-card and on-card comparison.

The compact format of signature/sign time series data is more compact than the full format defined in Clause 8. A signature/sign time series data record in compact format contains a single signature/

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sign representation; it does not contain a header and encodes each channel value within one byte only. Information about the structure and contents of the data record that otherwise would be given in the channel descriptions within the header is contained in a separate comparison algorithm parameters data object as defined in 9.2.

Figure 6 depicts the body of a signature/sign time series data record in compact format. The solid boxes indicate fields that shall be present. The dashed boxes indicate optional fields. The length of each field in bytes is indicated in parentheses at the bottom of the corresponding box. The ellipses indicate that more fields of the same format may follow.

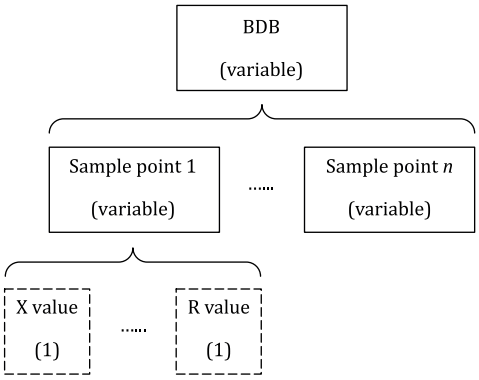

Figure 6 — Binary compact format

The informative Annex C specifies the abstract syntax of the binary compact format in ASN.1[1]. D.2 contains an encoding example in binary compact format.

9.2 Comparison algorithm parameters template

9.2.1 Structure

The comparison algorithm parameters data object may be embedded in a biometric header template (BHT), which is again embedded in a biometric information template (BIT) as defined in the TLV-encoded CBEFF patron format for use with smart cards or other tokens defined in ISO/IEC 19785-3.

The structure of a comparison algorithm parameters data object is shown in Table 6. Its tag is defined in ISO/IEC 19785-3 as $B1_{Hex}$. The length fields shall be encoded following the Distinguished Encoding Rules of ASN.1 defined in ISO/IEC 8825-1. Its contents may be a sequence of channel descriptions as defined in 9.2.3 and the maximum number of sample points that the comparison algorithm is able to process as defined in 9.2.2.

Table 6 — Structure of a comparison algorithm parameters data object for signature/sign time series data

Tag	Length	Value			Presence
$B1_{Hex}$	variable				
		Tag	**Length**	**Value**	
		81_{Hex}	variable	Minimum and maximum number of sample points as defined in 9.2.2	optional
		86_{Hex}	variable	Sequence of channel descriptions as defined in 9.2.3	optional

9.2.2 Minimum and maximum number of sample points

If there is a lower and an upper limit to the number of sample points, the minimum and maximum number of sample points that the comparison algorithm is able to process may be indicated in the comparison algorithm parameters data object. The minimum number of sample points shall be encoded

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in one byte as an unsigned integer, directly followed by the maximum number of sample points encoded as an unsigned integer, in as few bytes as possible (without leading zeros).

NOTE ISO/IEC 24787 recommends 81_{Hex} as tag for this data object.

9.2.3 Channel descriptions

9.2.3.1 Channel inclusion field

If present, the sequence of channel descriptions shall begin with a channel inclusion field as defined in 8.3.2.8.1.

9.2.3.2 Channel description preamble

The channel inclusion field shall be followed by a sequence of channel descriptions for the channels indicated as present in the channel inclusion field. The order of the channel descriptions is determined by the order of indicated inclusion within the channel inclusion field (Table 4) starting with the X channel if present. The channel descriptions are mandatory for all channels present in the signature/sign time series data record.

Each channel description shall begin with a preamble as defined in 8.3.2.8.2.

If any of the bits 4 through 8 of a channel description preamble are set to 1, the preamble shall be followed by a sequence of channel attributes in the same order as indicated in the preamble starting with the scaling value.

9.2.3.3 Scaling value

If present, the meaning and encoding of the scaling values shall be as defined in 8.3.2.8.3.

9.2.3.4 Minimum and maximum possible channel values

If present, the meaning of the minimum and maximum possible channel values shall be as defined in 8.3.2.8.4.

For the minimum and maximum possible channel values of the Z, T, DT, F, A, E and R channels, integer values in the range from 0 to 255 are allowed. These values shall be encoded in one byte as unsigned integers.

For the minimum and maximum possible channel values of the X, Y, VX, VY, AX, AY, TX and TY channels, integer values in the range from –128 to 127 are allowed. These values shall be encoded in one byte as unsigned integers after adding 128 to each value. Hence, for non-negative numbers, bit 8 of the most significant byte has the value 1; for negative numbers, bit 8 of the most significant byte has the value 0. For decoding these values, 128 is to be subtracted from each recorded value.

9.2.3.5 Average and standard deviation of the channel values

If present, the meaning of the average and of the standard deviation of the channel values shall be as defined in 8.3.2.8.5.

For the averages of the Z, T, DT, F, A, E, and R channels as well as for the standard deviations of all channels, integer values in the range from 0 to 255 are allowed. These values shall be encoded in one byte as unsigned integers.

For the averages of the X, Y, VX, VY, AX, AY, TX and TY channels, integer values in the range from 128 to 127 are allowed. These values shall be encoded in one byte as unsigned integers after adding 128 to each value. Hence, for non-negative numbers, bit 8 of the most significant byte has the value 1; for negative numbers, bit 8 of the most significant byte has the value 0. For decoding these values, 128 is to be subtracted from each recorded value.

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9.3 Embedment in a CBEFF data structure

According to the TLV-encoded patron format for use with smartcards or other tokens defined in ISO/IEC 19785-3, a signature/sign time series data record shall be encoded as shown in Table 7 or Table 8, depending on whether the signature/sign time series data record contains extended data or not. Its tag shall be $5f2e_{Hex}$ if there is no extended data, and $7f2e_{Hex}$ if there is also extended data. Its length shall be encoded following the Distinguished Encoding Rules of ASN.1 defined in ISO/IEC 8825-1. Its contents shall be the body of a signature/sign time series data record as defined in 9.4.

Table 7 — Signature/sign time series data record without extended data

Tag	Length	Value
$5f2e_{Hex}$	variable	Body of a signature/sign time series data record as defined in 9.4

Table 8 — Signature/sign time series data record alongside extended data

Tag	Length	Value		
$7f2e_{Hex}$	variable			
		Tag	**Length**	**Value**
		81_{Hex}	variable	Body of a signature/sign time series data record as defined in 9.4
		82_{Hex} or $A2_{Hex}$	variable	Extended data in proprietary format (of primitive or constructed type)

9.4 Record body

The record body consists of a sequence of fields, each of which consists of a sequence of channel values at a particular sample point, for subsequent sample points. For each sample point, the field shall consist of a sequence of selected channel values as indicated by the channel inclusion field in the comparison algorithm parameters data object. The order of the channel values is determined by the order of indicated inclusion within the channel inclusion field (Table 4).

For the Z, T, DT, F, A, E and R channels, integer values in the range from 0 to 255 are allowed. These values shall be encoded in one byte as unsigned integers. In the compact format, the T channel shall contain time data relative to the preceding sample.

For the X, Y, VX, VY, AX, AY, TX and TY channels, integer values in the range from –128 to 127 are allowed. These values shall be encoded in one byte as unsigned integers after adding 128 to each value. Hence, for non-negative numbers, bit 8 has the value 1; for negative numbers, bit 8 has the value 0. For decoding these values, 128 is to be subtracted from each recorded value.

For the S channel, the integer values 0 and 1 are allowed. These values shall be encoded in one byte as unsigned integers.

10 Binary compression format

10.1 Record organization

The compression format of signature/sign time series data is for use within applications where both, data record size and algorithm performance in terms of error rates, are important factors (for example, smart cards and other tokens) and also within applications where the data transmission speed can be slow.

The compression format has the advantage of smaller data size due to lossless data compression. As an inconvenience, it requires uncompressing the data in order to use them.

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A signature/sign time series data record in the compression format shall consist of the following data elements in the given order:

— a general header, containing descriptive information about the structure and contents of the data record,

— and a record body, containing at least one signature/sign representation.

Figure 7 depicts a signature/sign time series data record in compression format. The solid boxes indicate fields that shall be present. The dashed boxes indicate optional fields. The length of each field in bytes is indicated in parentheses at the bottom of the corresponding box. The ellipses indicate that more fields of the same format may follow.

D.3 contains an encoding example in binary compression format.

10.2 General header

The general header shall be as defined in 8.2 with the exception of the format identifier. The format identifier shall consist of the three ASCII characters "SCD" (534344_{Hex}) followed by Null (00_{Hex}) as a string terminator.

10.3 Record body

10.3.1 Structure

The record body shall consist of a sequence of at least one signature/sign representation. Each signature/sign representation shall consist of the following data elements in the given order:

— a representation header and

— a representation body.

10.3.2 Representation header

10.3.2.1 Structure

A representation header shall contain representation-specific descriptive information. A representation header shall consist of the following data elements in the given order:

— a representation-length field,

— the capture date and time,

— a capture device technology identifier,

— a capture device vendor identifier,

— a capture device type identifier,

— a quality record,

— a sequence of channel descriptions,

— a field indicating the number of sample points,

— a compression algorithm identifier field, and

— a field indicating the length of the compressed data.

The meaning and encoding of the representation-length field, the capture date and time field, the capture device technology identifier, the capture device vendor identifier, the capture device type

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