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AMENDMENT 2
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Information technology — Biometric data interchange formats —

Part 5: Face image data

AMENDMENT 2: Three-dimensional face image data interchange format

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

Partie 5: Données d'image de la face

AMENDEMENT 2: Format d'échange de données d'image de la face tridimensionnelles

Reference number
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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

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.

Amendment 2 to ISO/IEC 19794-5:2005 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

This amendment is intended to establish a data interchange format for storing three-dimensional (3D) human face images. To achieve this, several new image types are introduced that are a combination of 2D facial images and associated 3D shape information.

This amendment describes the necessary changes to the data interchange format regarding the capability to hold 3D information and the additional requirements for 3D data.

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Information technology — Biometric data interchange formats —

Part 5:
Face image data

AMENDMENT 2: Three-dimensional face image data interchange format

Page 3

Add the following reference to Clause 3:

ISO/IEC 15948:2004, *Information technology — Computer graphics and image processing — Portable Network Graphics (PNG): Functional specification*

Page 5

Replace 4.16 with the following:

4.16
2D image
two-dimensional representation that encodes the luminance and/or colour texture of a capture subject in a given lighting environment

Page 5

Add the following definitions to Clause 4:

4.24
3D image
representation that encodes a surface in a 3D space

4.25
3D point map
3D point cloud representing a capture subject, where each surface point is encoded with a triplet, representing the x, y and z values of the point in 3D

4.26
3D vertex representation
representation using 3D vertices and triangles between these points for coding of a 3D surface

4.27
anthropometric landmark
landmark point on the face used for identification and classification of humans

4.28
anthropometric landmark code
two-part code that defines an anthropometric landmark uniquely

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4.29
Cartesian coordinate system
3D orthogonal coordinate system

4.30
cylindrical coordinate system
three-dimensional polar coordinate system describing a point by the three components radius, azimuth and height

4.31
range image
numerical matrix that encodes a surface point in 3D space, where the position encodes the first two coordinates and the value at that position encodes the third coordinate

4.32
PNG format
lossless image compression standard specified in ISO/IEC 15948

4.33
texture
two-dimensional representation of the luminance and/or colour of a capture subject in a given lighting environment

4.34
texture projection matrix
3x4 matrix to transform a 3D surface coordinate from a metric Cartesian Coordinate System to a 2D texture image coordinate, where the transformation makes use of the 3D homogenous coordinates of the 3D point as well as the 2D homogenous coordinates of the 2D point

NOTE See bibliography item [13] for details.

Page 5

Replace clause 5.1 with the following:

5.1 Overview

The face record format specified in this document is a format to store face image data within a biometric data record. Each record shall pertain to a single subject and shall contain at least one or more 2D image and zero or more geometric representations (range images, 3D point maps, 3D vertex representations) of a human face. Depending on the face image type, a 3D representation of a face may be included in addition to the 2D image. This record is embedded in the biometric data block in a CBEFF compliant structure. The record structure is depicted in Figure 2 and Figure 3.

Adherence to this format requires compliance to the standards referred to above. In particular, the header and the entire data structure will be CBEFF compatible, 2D image data will be encoded using either JPEG or JPEG2000.

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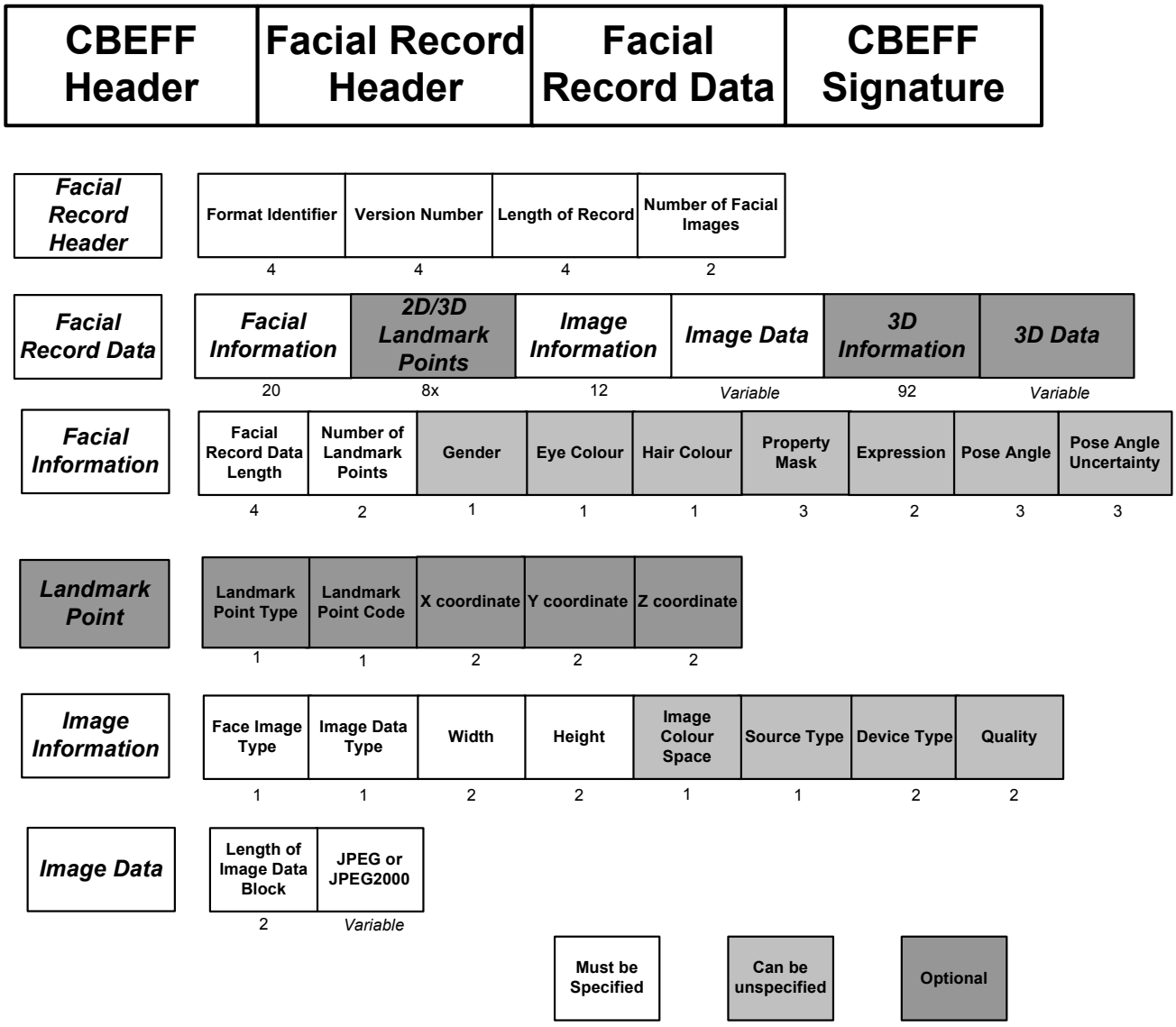

Figure 2 — The Face Image Record format. The length value of each field in bytes is shown below the field. The white boxes indicate fields or blocks that shall be specified, light grey boxes that the fields are mandatory, but an unspecified value is acceptable, and dark grey boxes indicate optional fields. Note, that the 3D Information block and 3D Data block are mandatory for the 3D Types.

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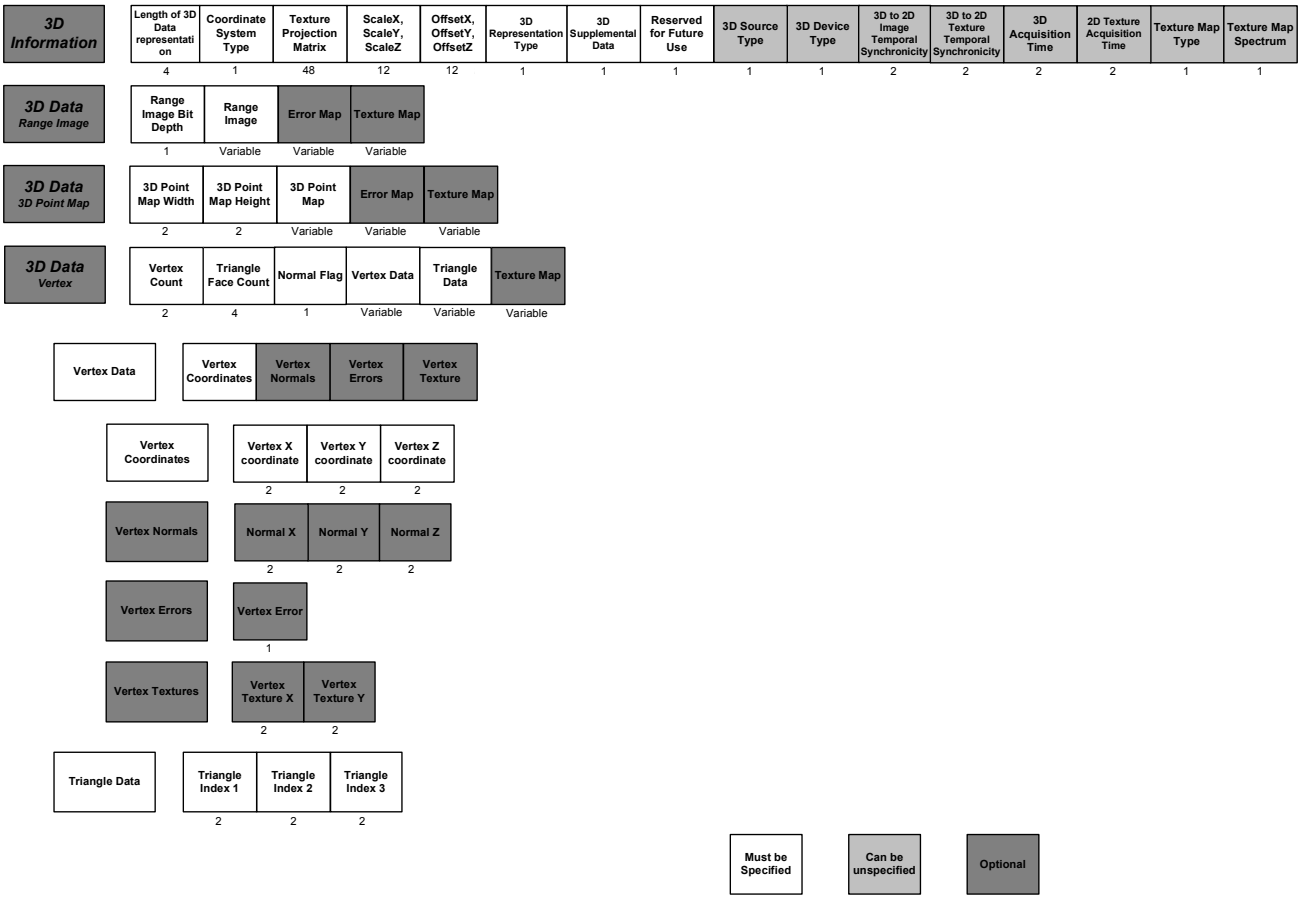

Figure 3 — The 3D Information block and the three possible 3D Data blocks specified in this standard. The length value of each field in bytes is shown below the field. The white boxes indicate fields or blocks that shall be specified, light grey boxes that the fields are mandatory, but an unspecified value is acceptable, and dark grey boxes indicate optional fields.

When referring to elements of the record format, 'field' denotes the elementary unit of information such as Face Image Type and Image Data Type, “block” denotes the group of fields such as Facial Information block or Image Information block, and “record” denotes the biometric reference which consists of the Facial Record Header and one or more Facial Record Data.

With the exception of the Format Identifier and the Version Number for the standard, which are null-terminated ASCII character strings, all data is represented in binary format.

There are no record separators or field tags; fields are parsed by byte count.

The organization of the record format is as follows:

- A fixed-length (14 byte) **Facial Record Header** containing information about the overall record, including the number of facial images represented and the overall record length in bytes.
- A **Facial Record Data** block for each facial image. This data consists of
    - A fixed length (20 byte) **Facial Information** block describing discernable characteristics of the subject such as gender.
    - Multiple (including none) fixed length (8 byte) **Landmark Point** blocks describing 2D or 3D Landmark Points on a face.

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- A fixed length (12 byte) **Image Information** block describing digital properties of the image such as Face Image Type and dimensions such as width and height.
- **Image Data** consisting of a JPEG or JPEG2000 encoded data block.
- For Face Image Types containing 3D information a **3D Information** block (92 byte) describing properties of this data.
- For Face Image Types containing 3D information the **3D Data** block describing the 3D shape of the face.

Multiple images / 3D-representations of the same biometric data subject can be described in a single CBEFF record. This is accomplished by including multiple Facial Record Data blocks after the Facial Record Header block and before the CBEFF Signature block. Facial Record Data blocks containing 2D data can be stored together with Facial Record Data blocks also containing 3D data. The structure of this embedding is illustrated in Figure Amd.2-1.

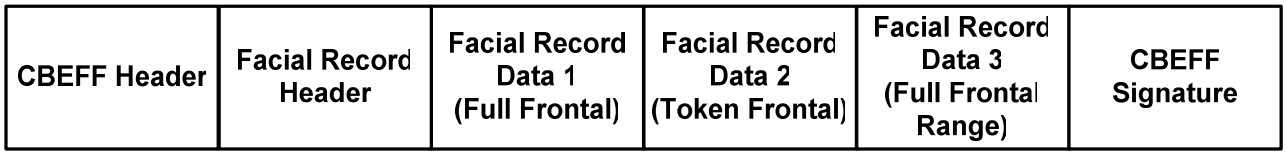

Figure Amd.2-1 – Embedding multiple images / 3D representations in the same record.

Page 8, 5.4

Replace Table 2 with the following:

Table 2 – The Facial Record Header

Field	Size	Valid values	Notes
Format Identifier	4 bytes	0x46414300 (‘F’ ‘A’ ‘C’ 0x0)	Indicates face image data
Version Number	4 bytes	0x30323000 (‘0’ ’ 2’ ’0’ 0x0)	“020” in ASCII
Length of Record	4 bytes	48 < Length of Record ≤ 2^{32} - 1	Includes Facial Record Header and Facial Record Data
Number of Facial Images / 3D representations	2 bytes	1 ≤ Number ≤ 65535	

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Replace clause 5.4.2 with the following:

5.4.2 Version Number

The (4 byte) Version Number field shall consist of three ASCII numerals followed by a zero byte as a NULL string terminator.

The first and second characters represent the major version number and the third character represents the minor revision number.

The Version Number of ISO/IEC 19794-5 shall be 0x30323000; “020” – Version 2 revision 0.

Page 15

Replace 5.6 with the following:

5.6 The Landmark Point block

The optional (8 byte) Landmark Point block specifies the type, code and position of a Landmark Point in the facial image. The number of Landmark Point blocks shall be specified in the Number of Landmark Points field of the Facial Information block. The structure of this block is shown in Table 8.

Landmark Points can be specified as MPEG-4 Feature Points as given by Annex C of ISO/IEC 14496-2:2004 or Anthropometric Landmarks in two or three dimensions. The description of the Anthropometric Landmarks and their relation with the set of MPEG4 Feature Points is discussed in clause 5.6.5.

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The horizontal and vertical position of Landmark Points are either texture image coordinates or in the Cartesian Coordinate system (see clause 5.9.2.1).

Table 8 – The Landmark Point block

Field	Size	Value	Notes
Landmark Point Type	1 byte	See clause 5.6.1	Denotes the type of the Landmark Point.
Landmark Point Code	1 byte	See clause 5.6.2	Denotes the Landmark Point, e.g. the left eye.
X coordinate, Y coordinate	2 bytes	See clause 5.6.1, Table Amd.2-1	Denotes the coordinate of the landmark point. For Landmark Point Types 0x01 and 0x02 this coordinate denotes the relevant pixel count from upper left pixel starting at 0. For Landmark Point Type 0x03 the value codes the coordinate of a point in 3D.
Z coordinate	2 bytes	See clause 5.6.1, Table Amd.2-1	Denotes the Z-coordinate of the landmark point. For Landmark Point Type 0x01 and Type 0x02 this field is ignored. For Landmark Point Type 0x03 the value codes the Z coordinate of a point in 3D.

5.6.1 Landmark Point Type

The (1 byte) Landmark Point Type field represents the type of the Landmark Point stored in the Landmark Point block. This field shall be set to 0x01 to denote that landmark point is an MPEG4 Feature Point as given by Annex C of ISO/IEC 14496-2:2004 and is represented by the 2D image coordinates. The field shall be set to 0x02 to denote that the landmark point is an Anthropometric 2D landmark and is represented by the 2D image coordinates. Finally, the field shall be set to 0x03 to denote that the landmark point is an Anthropometric 3D landmark and is represented by it's 3D coordinates. All other field values are reserved for future definition of Landmark Point types.

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Table Amd.2-1 — The Landmark Point Type

Description	Value	Comment
MPEG4 Feature	0x01	The Horizontal and Vertical position of the landmark point are measured in pixels with values from 0 to Width-1 and Height-1, respectively. The Z coordinate field is ignored.
Anthropometric 2D landmark	0x02	The landmark point is considered as a anthropometric landmark point in the 2-D image and its coordinates are measured in pixels with values from 0 to Width-1 and Height-1, respectively. The Z coordinate field is ignored.
Anthropometric 3D landmark	0x03	X coordinate, Y coordinate and Z coordinate are interpreted as 2 byte values with fixed precision of 0.02 mm ranging from -655.34 mm to 655.34 mm. The landmark point is considered as a 3D point in the Cartesian Coordinate System. *Example:* The value of 10001 corresponds to -655.34mm + 10001 x 0.02mm = -455.32mm.
Reserved	0x04-0xFF	Reserved for future use.

5.6.2 Landmark Point Code

The (1 byte) Landmark Point Code field shall specify the Landmark Point that is stored in the Landmark Point block.

For the Landmark Point Type 0x01 the codes of the Landmark Points in clause 5.6.3, taken from Annex C of ISO/IEC 14496-2:2004 and defined as MPEG4 Feature Points, or the additional eye and nostril Landmark Points in clause 5.6.4 shall be stored in this block.

If the Landmark Point Type is 0x02 or 0x03, i.e. Anthropometric 2D landmark or Anthropometric 3D landmark, the codes of the Landmark Points defined in 5.6.5 shall be stored in this block.

5.6.3 MPEG4 Feature Points

The normative Figure 6 denotes the Landmark Point codes associated with Feature Points as given by Annex C of ISO/IEC 14496-2:2004. Each Landmark Point code is represented by a notation A.B using a major (A) and a minor (B) value. The encoding of the Landmark Point code is given by the (1 byte) value of A*16 + B.

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