INTERNATIONAL STANDARD

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Information technology — Biometric data interchange formats —

Part 5:
Face image data

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

Partie 5: Données d'image de la face

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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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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 shall not be held responsible for identifying any or all such patent rights.

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

This second edition constitutes a technical revision of the first edition (ISO/IEC 19794-5:2005), which is provisionally retained. It also incorporates the Amendments ISO/IEC 19794-5:2005/Amd.1:2007 and ISO/IEC 19794-5:2005/Amd.2:2009, and the Technical Corrigenda ISO/IEC 19794-5:2005/Cor.1:2008 and ISO/IEC 19794-5:2005/Cor.2:2008. This edition reflects the harmonization across the second generation of ISO/IEC 19794. Clause 5 contains descriptions of the harmonized general and representation headers; and Clauses 5 to 13 have been technically revised. Annexes C, D, and E have been added.

ISO/IEC 19794 consists of the following parts, under the general title *Information technology — Biometric data interchange formats*:

— *Part 1: Framework*

— *Part 2: Finger minutiae data*

— *Part 3: Finger pattern spectral data*

— *Part 4: Finger image data*

— *Part 5: Face image data*

— *Part 6: Iris image data*

— *Part 7: Signature/sign time series data*

— *Part 8: Finger pattern skeletal data*

— *Part 9: Vascular image data*

— *Part 10: Hand geometry silhouette data*

— *Part 11: Signature/sign processed dynamic data*

— *Part 13: Voice data*

— *Part 14: DNA data*

Introduction

Face images, also commonly referred to as displayed portraits, have been used for many decades to verify the identity of persons. In recent years, digital face images are used in many applications including human examination as well as computer automated face recognition. Although photographic formats have been standardized in some cases such as for passports and driver licenses, there is a need to define a standard data format of digital face images to allow interoperability among vendors.

This part of ISO/IEC 19794 is intended to provide a face image format for face recognition applications requiring exchange of face image data. The typical applications are

1) human examination of facial images with sufficient resolution to allow a human examiner to ascertain small features such as moles and scars that might be used to verify identity,

2) human verification of identity by comparison of persons against facial images,

3) computer automated face biometric identification (one-to-many searching), and

4) computer automated face biometric verification (one-to-one comparison).

To enable many applications on a variety of devices, including devices that have limited resources available for data storage, and to improve face recognition accuracy, this part of ISO/IEC 19794 specifies not only a data format, but also scene constraints (lighting, pose, expression, etc.), photographic properties (positioning, camera focus, etc.) and digital image attributes (image resolution, image size, etc.).

Several face image types are introduced to define categories that satisfy requirements of some applications:

- **Basic:** This is the fundamental Face Image Type that specifies a record format including header and representation data. All Face Image Types adhere to the properties of this type. No mandatory scene, photographic and digital requirements are specified for this image type.

- **Frontal:** A Basic Face Image Type that adheres to additional requirements appropriate for frontal face recognition and/or human examination. Two types of Frontal Face Image Types are defined in this part of ISO/IEC 19794, Full Frontal and Token Frontal (or simply Token).

- **Full Frontal:** A Face Image Type that specifies frontal images with sufficient resolution for human examination as well as reliable computer face recognition. This type of Face Image Type includes the full head with all hair in most cases, as well as neck and shoulders. This image type is suitable for permanent storage of the face information, and it is applicable to portraits for passport, driver license, and "mugshot" images.

- **Token Frontal:** A Face Image Type that specifies frontal images with a specific geometric size and eye positioning based on the width and height of the image. This image type is suitable for minimizing the storage requirements for computer face recognition tasks such as verification while still offering vendor independence and human verification (versus human examination which requires more detail) capabilities.

- **Post-processed Frontal:** Applying digital post-processing to a captured image can modify this image in a way that it is more suitable for automatic face recognition. The Post-processed Frontal Face Image Type is thought of as the interchange format for these kinds of facial images.

- **Basic 3D:** The Basic 3D Image Type is the base Image Type of all 3D Face Image Types. All 3D Face Image Types obey normative requirements of this image type.

- **Full Frontal 3D:** The Full Frontal 3D Image Type combines a Full Frontal 2D image with additional 3D information.

- **Token Frontal 3D:** The Token Frontal 3D Image Type combines a Token Frontal 2D image with additional 3D information.

Table 1 shows the relationships between Face Image Types using the notion of inheritance. For example, Frontal inherits properties from Basic, which means that all normative clauses that apply to Basic also apply to Frontal.

Table 1 — Inheritance of Face Image Types

Face Image Type	Inherits from	Normative clauses	Informative annexes
Basic	None	1, 2, 3, 4, 5, 6	B.1
Frontal	Basic	7	B.2
Full Frontal	Frontal	8	B.3
Token Frontal	Frontal	9	B.4
Post-processed Frontal	Frontal	10	

Figure 1 gives a general overview of the scene, photographic, digitization, and format requirements for the face image types specified in this part of ISO/IEC 19794.

Requirements			
Scene	**Photographic**	**Digital**	**Format**
Lighting	Positioning	Digital Camera	Digital Specifications
Image and Subject	Camera Attributes	Analogue to Digital	Record Format and Organization
		Image Scanning	
Clauses:	*Clauses:*	*Clauses:*	*Clauses:*
Basic Face — None	Basic Face — None	Basic Face — None	Basic Face — 5, 6.2, 6.3, 6.4
Frontal Face — 7.2	Frontal Face — 7.3	Frontal Face — 7.4	Frontal Face — 7.5
Full Frontal Face — 8.2	Full Frontal Face — 8.3	Full Frontal Face — 8.4	Full Frontal Face — 8.5
		Token Face — 9.2	Token Face — 9.3
			Post-processed Frontal Face — 10.3

Figure 1 — The types of imaging requirements specified in this part of ISO/IEC 19794. The Basic Face Image Type has no scene, photographic, or digital requirements

This is a revision of ISO/IEC 19794-5:2005. The structure of the data format is not compatible with the previous version.

NOTE   This part of ISO/IEC 19794 relies on other ISO International Standards.

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ISO/IEC 19794-5:2011
https://standards.iteh.ai/catalog/standards/sist/a1b19a29-398d-436c-8826-
aeb8cfc7df91/iso-iec-19794-5-2011

Information technology — Biometric data interchange formats —

Part 5:
Face image data

1 Scope

This part of ISO/IEC 19794

— specifies a record format for storing, recording, and transmitting the information from one or more facial images or a short video stream of facial images,

— specifies scene constraints of the facial images,

— specifies photographic properties of the facial images,

— specifies digital image attributes of the facial images,

— provides best practices for the photography of faces.

2 Conformance

A biometric data record conforms to this part of ISO/IEC 19794 if it satisfies all of the normative requirements related to:

A) Its data structure, data values and the relationships between its data elements, as specified in Clauses 5, 6, 7, 8 for the Full Frontal Face Image Type, Clauses 5, 6, 7, 9 for the Token Frontal Image Type, and Clauses 5, 6, 7, 10 for the Post-processed Frontal Image Type of this part of ISO/IEC 19794, respectively.

B) The relationship between its data values and the input biometric data from which the biometric data record was generated, as specified in Clauses 5, 6, 7, 8 for the Full Frontal Face Image Type, Clauses 5, 6, 7, 9 for the Token Frontal Image Type, and Clauses 5, 6, 7, 10 for the Post-processed Frontal Image Type of this part of ISO/IEC 19794, respectively.

A system that produces biometric data records is conformant to this part of ISO/IEC 19794 if all biometric data records that it outputs conform to this part of ISO/IEC 19794 (as defined above) as claimed in the Implementation Conformance Statement associated with that system. A system does not need to be capable of producing biometric data records that cover all possible aspects of this part of ISO/IEC 19794, but only those that are claimed to be supported by the system in the Implementation Conformance Statement.

A system that uses biometric data records is conformant to this part of ISO/IEC 19794 if it can read, and use for the purpose intended by that system, all biometric data records that conform to this part of ISO/IEC 19794 (as defined above) as claimed in the Implementation Conformance Statement associated with that system. A system does not need to be capable of using biometric data records that cover all possible aspects of this part of ISO/IEC 19794, but only those that are claimed to be supported by the system in an Implementation Conformance Statement.

3 Normative references

The following referenced documents are indispensable for the application 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/IEC 10918-1, *Information technology — Digital compression and coding of continuous-tone still images: Requirements and guidelines*

ISO/IEC 14496-2:2004, *Information technology — Coding of audio-visual objects — Part 2: Visual*

ISO/IEC 15444-1, *Information technology — JPEG 2000 image coding system: Core coding system*

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

ISO/IEC 19794-1:2011, *Information technology — Biometric data interchange formats — Part 1: Framework*

ISO/IEC 29794-1, *Information technology — Biometric sample quality — Part 1: Framework*

4 Terms and definitions

For the purposes of this document, the terms and definitions as well as abbreviated terms given in ISO/IEC 19794-1 and the following apply.

4.1
2D image
two-dimensional face representation that encodes the luminance and/or colour texture of a capture subject in a given lighting environment

4.2
3D image
three-dimensional face representation that encodes a surface in a 3D space

4.3
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 value of the point in 3D respectively

4.4
3D vertex representation
representation using 3D vertices and triangles between these points for coding of a 3D surface

4.5
anthropometric landmark
landmark point on the face used for identification and classification of humans

4.6
anthropometric landmark code
two-part code that defines an anthropometric landmark uniquely

4.7
Cartesian coordinate system
3D orthogonal coordinate system

4.8
chin
central forward portion of the lower jaw

4.9
colour image
continuous-tone image that has more than one channel, each of which is coded with one or multiple bits

4.10
colour space
way of representing colours of pixels in an image

EXAMPLE   RGB, YUV and greyscale colour spaces are typically used in this part of ISO/IEC 19794.

4.11
crown
top of the head, or (if obscured by hair or headwear) where the top of the head/skull would be if it could be seen

4.12
cylindrical coordinate system
three-dimensional polar coordinate system describing a point by the three components radius, azimuth and height

4.13
dots per inch (DPI)
measurement of scanner and printer spatial sampling rate

4.14
facial image
electronic image-based representation of the portrait of a person

4.15
face image type
category of facial images that satisfy specific requirements

4.16
feature point
reference point in a face image as used by face recognition algorithms

NOTE   Commonly referred to as a landmark, an example being the position of the eyes.

4.17
fish eye
type of distortion where central objects of the image erroneously appear closer than those at the edge

4.18
greyscale image
continuous-tone image encoded with one luminance channel

NOTE   For example, if the luminance channel is coded with 8 bits, the greyscale image is also referred to as a monochrome or black and white image.

4.19
human examination
process of careful human comparison of a face image with a person or another face image to ascertain the identity of the respective person by a detailed examination of facial characteristics and structures

4.20
human verification
validation of the identity of a face image by means of comparison with a person or other face image

NOTE   Also known as one-to-one (1:1) comparison.

4.21
JPEG
image compression standard specified as ISO/IEC 10918-1

NOTE   The JPEG baseline standard was published as ISO/IEC 10918-1 and ITU-T Rec. T.81.

4.22
JPEG2000
image compression standard specified as ISO/IEC 15444-1

NOTE   The JPEG2000 baseline standard was published as ISO/IEC 15444-1 and ITU-T Rec. T.800.

4.23
PNG format
lossless image compression standard specified in ISO/IEC 15948

4.24
portrait
photograph of a person which includes the full head, with all hair in most cases, as well as neck and top of shoulders

4.25
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

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4.26
red-eye
red glow from a subject's eye caused by light from flash reflecting from blood vessels behind the retina

4.27
texture
two-dimensional representation of the luminance and/or colour of a capture subject in a given lighting environment

4.28
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 homogeneous coordinates of the 3D point as well as the 2D homogeneous coordinates of the 2D point

NOTE   See reference [2] for details.

5   The Face Image Data Record Format

5.1   Overview

The ISO/IEC 19794-5 BDIR format specified in this part of ISO/IEC 19794 is a format to store face representations within a biometric data record. Each BDIR 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 representation. 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, 2D image data will be encoded using JPEG, JPEG2000 or PNG.

When referring to elements of the record format, "field" denotes the singular element 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 data that consists of the General Header and one or more Representations.
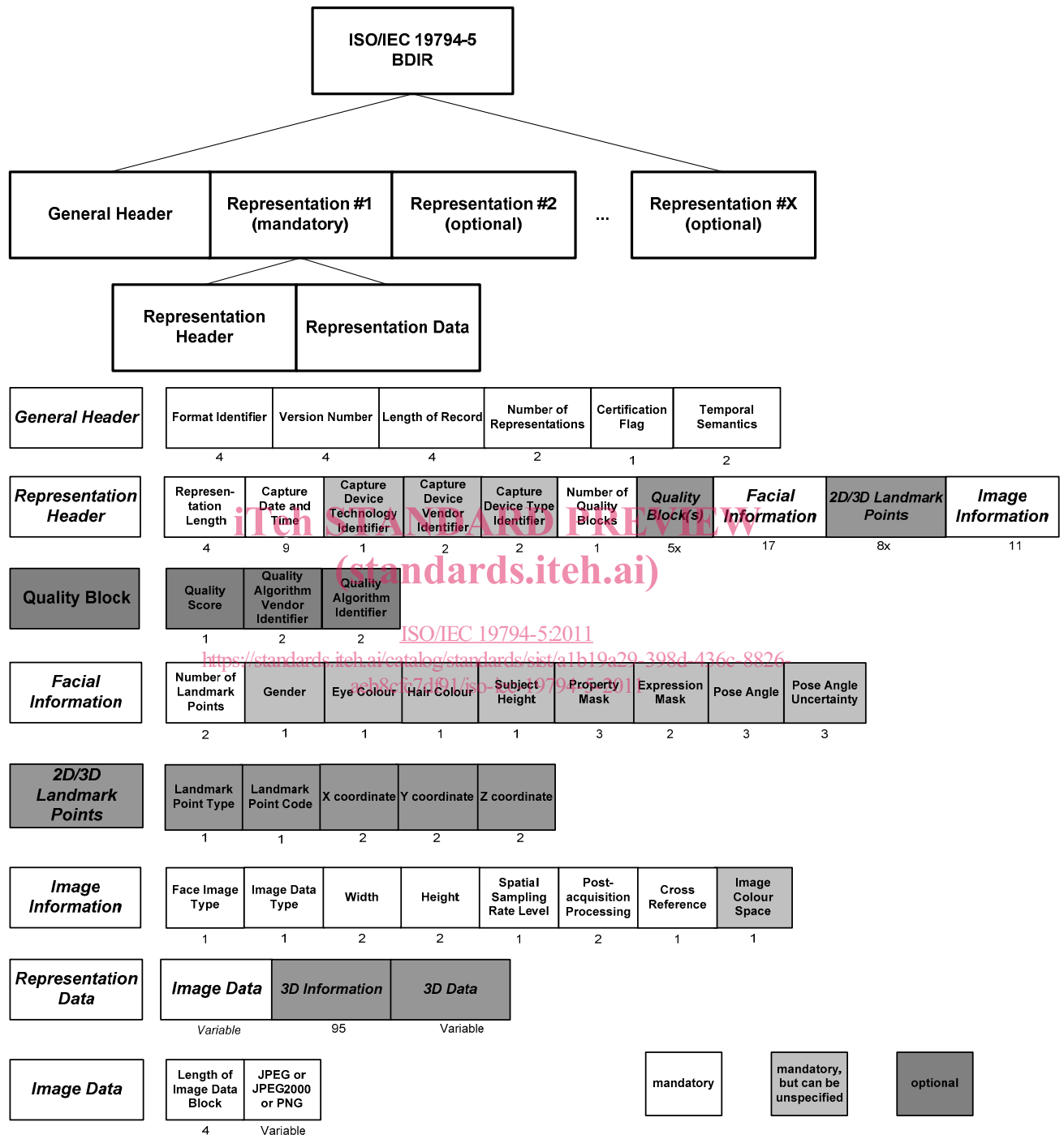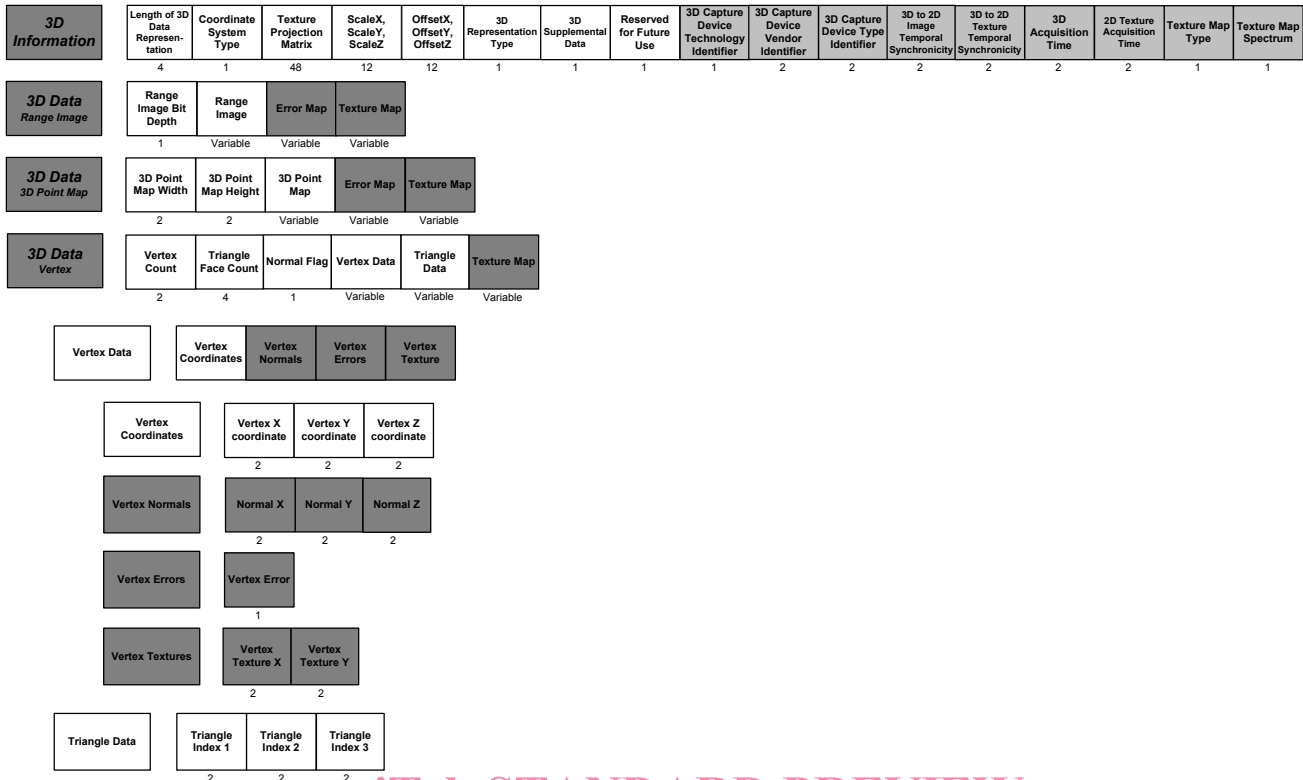

Figure 2 — The ISO/IEC 19794-5 Biometric Data Interchange Record. The length value of each field in bytes is shown below the field. The white boxes indicate fields or blocks that shall be specified, and dark grey boxes indicate optional fields.

5

3D Information

Length of 3D Data Representation	Coordinate System Type	Texture Projection Matrix	ScaleX, ScaleY, ScaleZ	OffsetX, OffsetY, OffsetZ	3D Representation Type	3D Supplemental Data	Reserved for Future Use	3D Capture Device Technology Identifier	3D Capture Device Vendor Identifier	3D Capture Device Type Identifier	3D to 2D Image Temporal Synchronicity	3D to 2D Texture Temporal Synchronicity	3D Acquisition Time	2D Texture Acquisition Time	Texture Map Type	Texture Map Spectrum
4	1	48	12	12	1	1	1	1	2	2	2	2	2	2	1	1

3D Data — Range Image

Range Image Bit Depth	Range Image	Error Map	Texture Map
1	Variable	Variable	Variable

3D Data — 3D Point Map

3D Point Map Width	3D Point Map Height	3D Point Map	Error Map	Texture Map
2	2	Variable	Variable	Variable

3D Data — Vertex

Vertex Count	Triangle Face Count	Normal Flag	Vertex Data	Triangle Data	Texture Map
2	4	1	Variable	Variable	Variable

Vertex Data: Vertex Coordinates | Vertex Normals | Vertex Errors | Vertex Texture

Vertex Coordinates

Vertex X coordinate	Vertex Y coordinate	Vertex Z coordinate
2	2	2

Vertex Normals

Normal X	Normal Y	Normal Z
2	2	2

Vertex Errors

Vertex Error
1

Vertex Textures

Vertex Texture X	Vertex Texture Y
2	2

Triangle Data

Triangle Index 1	Triangle Index 2	Triangle Index 3
2	2	2

Legend: mandatory | mandatory, but can be unspecified | optional

Figure 3 — The 3D Information block and the three possible 3D Data blocks specified in this part of ISO/IEC 19794. 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.

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 (17 byte) **General Header** containing information about the overall record, including the number of facial images represented and the overall record length in bytes.

- A Representation block for each facial representation. This data consists of a Representation Header and the Representation Data.

- The Representation Header consists of

    o A fixed length (19 bytes) common elements defined in ISO/IEC 19794-1:2011

    o Multiple (including none) fixed length (5 byte) **Quality** blocks describing the quality of the representation.

    o A fixed length (17 byte) **Facial Information** block describing discernable characteristics of the subject such as gender.

    o Multiple (including none) fixed length (8 byte) **Landmark Point** blocks describing Landmark Points in a facial image.

    o A fixed length (11 byte) **Image Information** block describing digital properties of the image such as Face Image Type and dimensions such as width and height.

- The Representation Data consists of

  o **Image data** consisting of a JPEG, JPEG2000 or PNG encoded data block.

  o For Face Image Types containing 3D information a **3D Information** block (95 byte) describing properties of this data.

  o For Face Image Types containing 3D information the **3D Data** block describing the 3D shape of the face.

Multiple 2D / 3D representations of the same biometric data subject can be described in a single record. This is accomplished by including multiple representation blocks after the General Header block. Representation blocks containing 2D data can be stored together with Representation blocks also containing 3D data. The structure of this embedding is illustrated in Figure 4.
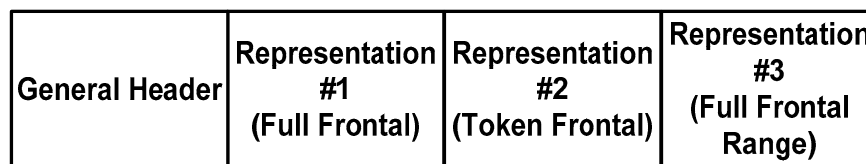
General Header	Representation #1 (Full Frontal)	Representation #2 (Token Frontal)	Representation #3 (Full Frontal Range)

Figure 4 — Embedding multiple 2D / 3D representations in the same record

5.2 Data Conventions

5.2.1 Byte ordering

Within the record format and all well-defined data blocks therein, all multi-byte quantities are stored in Big-Endian format. That is, the more significant bytes of any multi-byte quantity are stored at lower addresses in memory than less significant bytes. For example, the value 1 025 (2 to the 10th power plus one) would be stored as first byte= 00000100 and second byte=00000001.

5.2.2 Numeric values

All numeric values are fixed-length unsigned integer quantities, unless otherwise specified.

5.2.3 Conversion to integer

The conversion of a numeric value to integer is given by rounding down if the fractional portion is less than 0,5 and rounding up if the fractional value is greater than or equal to 0,5.

5.2.4 Unspecified field value

In Figure 2 and Figure 3 the following fields are mandatory, but the value of the field can indicate that the field is unspecified: Capture Device Technology Identifier, Capture Device Vendor Identifier, Capture Device Type Identifier, Gender, Eye Colour, Hair Colour, Subject Height, Property, Expression, Pose Angle, Pose Angle Uncertainty, Image Colour Space, 3D Capture Device Technology Identifier, 3D Capture Device Vendor Identifier, 3D Capture Device Type Identifier, 3D to 2D Image Temporal Synchronicity, 3D to 2D Texture Temporal Synchronicity, 3D Acquisition Time, 2D Texture Acquisition Time, Texture Map Type, and Texture Map Spectrum.

5.2.5 Unknown field value

A field value labelled by the identifier "Unknown" shall be used to denote that the information encoded by the field cannot be determined by examination of the face image.