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Information technology — Biometric data interchange formats —

Part 9: Vascular image data

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

Partie 9: Données d'images vasculaires

Reference number
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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 the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

ISO/IEC 19794-9 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

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*

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Introduction

Vascular biometric technologies have existed for many years. Additionally, new technologies employing vascular images obtained from various parts of the human body are emerging or under continuous improvement as a result of new, state-of-the-art imaging devices. Some of them are being widely adopted as reliable biometric modalities.

Currently, however, little vascular biometric image information is being exchanged between the equipment and devices from different vendors. This is due in part to the lack of standardized formats for information exchange that would ensure interoperability among the various vendors.

The purpose of this part of ISO/IEC 19794 is to define a proposed standard for the exchange of human vascular biometric image information. It defines a specific definition of attributes, a data record format for storing and transmitting vascular biometric images and certain attributes, a sample record, and conformance criteria.

This part of ISO/IEC 19794 is intended for applications requiring the exchange of raw or processed vascular biometric images. It is intended for applications not limited by the amount of storage required. It is a compromise or a trade-off between the resources required for data storage or transmission and the potential for improved data quality/accuracy. Basically, it is to enable various algorithms to identify or verify the vascular biometric image data transferred from other image sources. Currently available vascular biometric technologies that may utilize this part of ISO/IEC 19794 for image exchange are technologies that use the back of the hand, palm and finger.

The use of captured source images can provide interoperability among and between vendors relying on various different recognition or verification algorithms. Accordingly, data from the captured vascular biometric image offers the developer more freedom in choosing or combining matching algorithm technology.

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Information technology — Biometric data interchange formats —

Part 9: Vascular image data

1 Scope

This part of ISO/IEC 19794 specifies an image interchange format for biometric person identification or verification technologies that utilize human vascular biometric images and may be used for the exchange and comparison of vascular image data. It specifies a data record interchange format for storing, recording, and transmitting vascular biometric information from one or more areas of the human body. It defines the contents, format and units of measurement for the image exchange. The format consists of mandatory and optional items, including scanning parameters, compressed or uncompressed image specifications and vendor-specific information. Information compiled and formatted in accordance with this part of ISO/IEC 19794 can be recorded on machine-readable media or may be transmitted by data communication facilities.

Vascular biometric image data that comply with this part of ISO/IEC 19794 are intended to be embedded in a CBEFF-compliant structure in the CBEFF Biometric Data Block (BDB) as specified in ISO/IEC 19785-1.

2 Conformance

Applications claiming conformance with this part of ISO/IEC 19794 shall be capable of encoding and decoding vascular biometric image data and the associated parameter data used in the transmitting and/or receiving of vascular biometric images as defined by this part of ISO/IEC 19794. Minimum conformance shall require the ability to transmit (exchange) and extract interoperable vascular biometric information

Since the size of the human body areas used by vascular biometric technologies varies dramatically among the different technologies, the recommended image quality criteria described in this part of ISO/IEC 19794 should be associated with specific technologies. Therefore, it would be unreasonable to specify the minimum requirement of the spatial resolution of an image in a single standard format. Accordingly, the minimum requirement of the spatial resolution is not defined in this part of ISO/IEC 19794.

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

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

ISO/IEC 10918 (all parts), *Information technology — Digital compression and coding of continuous-tone still images*

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ISO/IEC 15444 (all parts), *Information technology — JPEG 2000 image coding system*

ISO/IEC 14495 (all parts), *Information technology — Lossless and near-lossless compression of continuous-tone still images*

4 Terms and definitions

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

4.1
capture
acquire vascular biometric image data from an individual

4.2
centroid
centre of gravity

NOTE In this part of ISO/IEC 19794, it is used to define a unique location within a silhouette image that can be assumed as the origin of a coordinate system.

4.3
gray scale
continuous-tone image that has one component, which is luminance

4.4
pixel
picture element

NOTE A digital image is a matrix with pixels organized in row-column format. A digital image with M by N components of gray scale or color values consists of M × pixels.

4.5
raw
image file format in which the image is stored in the same format in which it is stored in video memory, typically one byte (for monochrome images) per picture element or three bytes (for color images) per picture element

NOTE This format does not contain any information related to the image and/or imaging parameters.

4.6
scan resolution
spatial resolution
number of pixels per unit distance

NOTE Horizontal scan resolution can be different from vertical scan resolution.

4.7
vascular biometric image
captured raw or processed image that contains physical characteristics or traits of vascular pattern used to recognize the identity or verify the claimed identity of an individual

4.8
vascular image header record
information contained in the header data structure of the vascular image data format as specified in this part of ISO/IEC 19794

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4.9
ventral
palm side of a finger or a hand

4.10
dorsal
back side of a finger or a hand

4.11
transaction
command, message or input record that explicitly or implicitly calls for a processing action

NOTE Information contained in a transaction is applicable to a single subject.

5 Abbreviated terms

nm nanometre

ppcm pixels per centimetre

ROI region of interest

VIR vascular biometric image record (designates all data records which this part of ISO/IEC 19794 specifies)

6 Data conventions

6.1 Byte and bit ordering

The quantities in all records and vascular biometric image elements (pixel data), if represented as multibyte quantities, are represented in big-endian format. That is, the more significant bytes of any multibyte quantity are stored at lower addresses in memory than are the less significant bytes. The order for transmission shall also be the most significant byte first and the least significant byte last. Within a byte, the order of transmission shall be the most significant bit first and the least significant bit last. All numeric values are unsigned integer quantities of fixed-length.

6.2 Scan sequence

A raw vascular image data conforming to this part of ISO/IEC 19794 is a two dimensional bit-mapped data that scans an object from the upper left corner to the lower right corner within a region of interest of a human body. This standard defines the scan direction of an imaging sensor as being along the positive x and y-axis which is defined in 7.9 for each vascular biometric technology, assuming the target human body (finger, back of the hand, or palm, etc.) is positioned in standard pose. The standard pose is defined in 7.8. If an image is scanned in a standard pose, the x and y-axis of the object coordinate system is in parallel with the x and y-axis of the image coordinate system. The x-direction of the image coordinate system is defined as the scan line from left to right and the y-direction as being from the top to the bottom of the image. Additionally, in a standard pose, the object z-axis is assumed to be in a direction parallel with the z-axis of the imaging device.

The scan sequence shall be raster scan order; that is, image pixels are acquired along the x-axis from top to bottom in the y-direction. In order to map the object coordinate system to the image coordinate system without further translation, each vascular biometric image data may define the x and y-axis origin which is not the pixel location of the upper-left corner of the image. If the origin is not specifically defined, it shall be the pixel location of the upper-left corner of the image.

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7 Image capture requirements

7.1 Spatial resolution

Image capture requirements are dependent on various factors such as the type of application, the available amount of raw pixel information to be retained or exchanged, and the targeted performance. Another factor to consider as a requirement for vascular biometric imaging is that the physical size of the target body area where an application captures an image for the extraction of vascular pattern data varies substantially (unlike other biometric modalities). For example, a finger vein biometric device may require more spatial resolution than a palm vein device due to the size difference of biometric features. Therefore, this standard does not specify the requirement of minimum spatial resolution. However, the spatial resolution of the captured image shall be represented in terms of pixels per centimetre.

7.2 Gray scale depth

The image shall have a dynamic range spanning at least 128 gray scale levels, allocating at least one byte (8 bits) per intensity value and providing at least 7 bits of useful intensity information. The image may utilize two or more bytes per gray scale value instead of one.

7.3 Illumination

For the capture of vascular biometric images, the skin is typically illuminated using near-infrared wavelengths in the range of approximately 700 to 1 200 nm. The angle from the light source to the tangent plane of the skin's surface is not defined in VIR because technologies that use a reflectance image may use diffuse illumination instead of direct illumination for the purpose of avoiding specular reflectance. Instead, this standard specifies that the image is either based on transparency or reflectance of target features. Two or more wavelengths of illumination light source may be specified in the case that multiple different light sources are used for background masking.

7.4 Pixel aspect ratio

The default pixel aspect ratio is 1:1. If the image is not of square pixels, the aspect ratio shall be described.

7.5 Normalization of projection

The captured image shall be an orthographic projection of the body area being imaged. If the original raw image is not orthographic to the body area, it shall be converted to an orthographically projected one. Any major geometric distortion caused by the optical system shall also be eliminated prior to creation of the VIR.

7.6 Image storage format

The captured vascular image shall be transmitted and stored in one of several possible formats described in the following paragraphs.

7.6.1 Raw format

The image is represented by a rectangular array of pixels with specified numbers of columns and rows. Each pixel has at least 8 bits of information. There is no image header, and each pixel in a monochrome image is represented by one or more bytes. Color images are represented as three samples per pixel, each comprised of one or more bytes, representing red, blue, and green (RGB) intensities, in that order. The image is organized in row-major order, with the lowest address corresponding to the upper left corner of the image. If the pixel intensity value is represented by more than one byte, the bytes shall be stored in big-endian order.

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7.6.2 Lossless compression format

If lossless compression is used the image data shall be compressed in accordance with the JPEG-LS lossless compression algorithm specified in ISO/IEC 14495 or the JPEG2000 compression algorithm specified in ISO/IEC 15444.

7.6.3 Lossy compression format

If lossy compression is used the image shall be compressed in accordance with the JPEG compression algorithm specified in ISO/IEC 10918 or the JPEG2000 compression algorithm specified in ISO/IEC 15444. If one of these compression algorithms is used, a compression factor of 4:1 or less is recommended.

7.6.4 Multichannel image format

Images may be acquired utilizing more than three colors or channels utilizing multichannel cameras. In this case, pixel values may not be directly related to specific colors, rather they may be related to certain physical characteristics. Images captured with more than three sensing channels shall be stored in accordance with the JPEG2000 compression algorithm as specified in ISO/IEC 15444.

7.7 Imaging area

Vascular pattern biometric technologies obtain images from different locations of the human body. The technologies currently available employ images from the finger, back of the hand, and palm side of the hand. The location used for imaging shall be specified in the format. Also, the direction (left/right) of hand and/or finger index (thumb, index, middle, ring, and little) shall be specified. This part of ISO/IEC 19794 reserves fields for future development of technologies that may utilize different parts of human body.

7.8 Standard pose

This part of ISO/IEC 19794 defines the standard poses to capture raw images of target body areas. Based on these standard poses, object (target area of the human body) coordinate systems are defined as described in 7.9.

7.8.1 Back of the hand

The standard pose for the back of the hand shall be to position the hand with the dorsal side toward the capture device with the tangent plane of the back of the hand in parallel with the image coordinate space to produce an orthographic image of the back of the hand. An example of the standard pose of the back of the hand is shown in Figure 1. In the standard pose, the camera's direction is parallel to the z-axis of the back of the hand coordinate system defined in 7.9.1.

7.8.2 Palm

The palm area shall not be bent and each finger boundary shall be exposed to the camera. Fingers shall be straight. An example of the standard pose of a palm is shown in Figure 2. In the standard pose, the camera's direction is parallel to the z-axis of the palm coordinate system defined in 7.9.2.

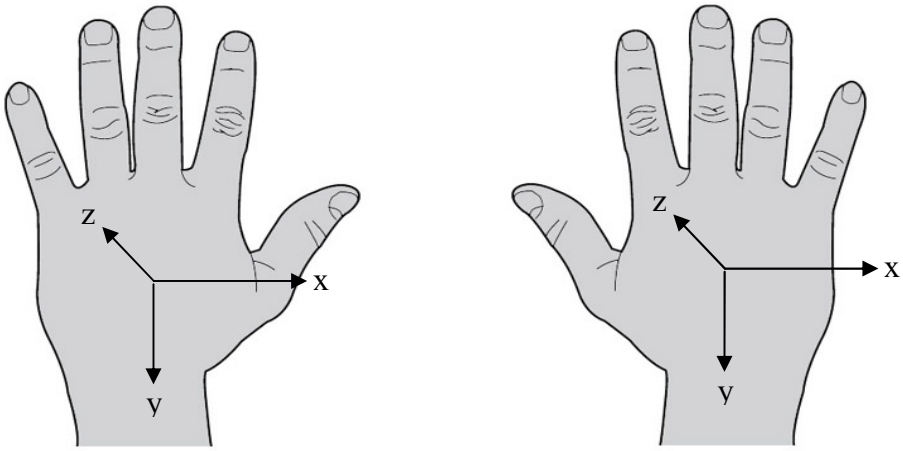
7.8.3 Finger

The standard pose is a straight finger. For clarity, the "frontal side" is defined as the ventral side of each finger. An example of the standard pose of a finger is shown in Figure 3.

7.8.4 Standard poses for future modalities

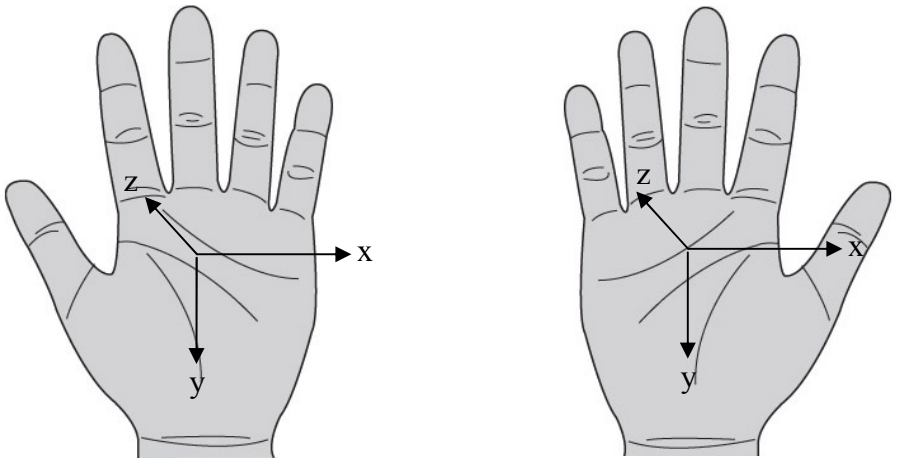
The format shall reserve standard pose definitions of future technologies that may utilize different part of the human body.

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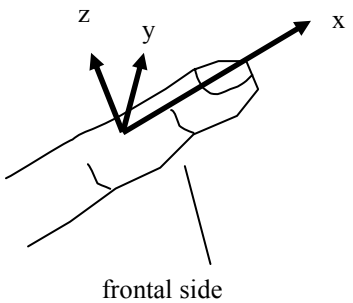
Left hand Right hand

Figure 1 — Standard pose and object coordinate system of the back of the hand vascular biometrics. The Euclidean direction is right-handed.



Left hand Right hand

Figure 2 — Standard pose and object coordinate system of palm vascular biometrics. The Euclidean direction is right-handed.



z-axis: (minus) normal to the frontal side

x-axis: the direction from root to tip

Figure 3 — Standard pose and object coordinate system of finger vascular biometrics. The Euclidean direction is right-handed.

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7.9 Object coordinate system

The vascular image header record provides an optional field that specifies the degree of rotation of the vascular image out of the standard pose. To effectively specify the rotation angle, the object (target body) coordinate system for each vascular technology is defined in this clause. All of the coordinate systems are right-handed Euclidian coordinate systems.

7.9.1 Back of the hand

The y-axis of a back of the hand object is along the opposite direction of the middle finger, while the x-axis is perpendicular to the y-direction along the tangent plane on the back of the hand as shown in Figure 1. The z-axis shall be orthogonal to both the x-axis and the y-axis. The positive z-axis direction is away from the imaging device, which follows the right-handed Euclidean coordinate system. The origin of the object coordinate system is defined as the centroid of the hand silhouette image.

7.9.2 Palm

The y-axis of a palm object is along the opposite direction of the middle finger, while the x-axis is perpendicular to the y-direction on the palm plane as shown in Figure 2. The z-axis shall be determined by the right-handed Euclidean coordinate system; thus the positive direction of z-axis is away from the imaging device. The origin of the object's coordinate system is defined as the centroid of hand silhouette image.

7.9.3 7.9.3 Finger

The x-axis is defined as the direction from the root to the tip of a finger as shown in Figure 3. The z-axis is the direction perpendicular to the x-axis and away from the frontal side. The y-axis is perpendicular both to the x and the z-axes with the direction following the right-handed Euclidean coordinate system. The origin of the finger coordinate system is defined as the centroid of the finger silhouette image

7.9.4 Coordinate systems for future modalities

The format shall reserve object coordinate system definitions for future technologies that may utilize different parts of the human body.

8 Vascular image format specification

8.1 Vascular image data block

Table 1 shows the basic structure of the vascular image biometric data block. A single data block starts with a vascular image record header, which contains general information on the data block such as the identification of the image capture device and the format version. One or more vascular image blocks follow the record header. Each image block consists of an image header and raw or compressed image data. The image header contains all the image specific information such as the body location, rotation angle, and imaging conditions. Each image header data shall be stored in big-endian format, where bit-level data definitions are specified as: bit 1 shall be interpreted as the least significant bit (LSB).

8.2 Vascular image record header

The vascular image record header defines general information on the vascular images contained in the data block, such as the format version number, total length of the record block, capture device identification, and the number of images contained in the data block. The record header format is shown in Table 2.

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Table 1 — Vascular image biometric data block

Bytes	Type	Content	Description
1 – 26		Vascular image record header	Header used by all vascular biometric image providers. Information on format version, capture device ID, number of vascular images contained in the VIR, etc.
27 – 58		Vascular image header	Image header for the first image. Contains all individual image specific information
	Unsigned char	Image data	
		• • •	• • •
		Vascular image header	Image header for the last image
	Unsigned char	Image data	

Table 2 — Vascular image record header

Bytes	Type	Content	Description
1 – 4	Unsigned char	Format Identifier	'V' 'I' 'R' 0x00 (Vascular Image Record)
5 – 8	Unsigned char	Format version	'n' 'n' 'n' 0x00 Header format version. May be subdivided into major and minor versions
9 – 12	Unsigned int	Record length	Total length of data record in bytes
13 – 14	Unsigned short	Capture device ID	Capture device ID assigned by vendor of equipment used to capture image data CAPTURE_DEVICE_UNDEF = 0 (0x0000)
15 – 16	Unsigned short	Number of images	Number of images that a vascular image record block contains
17 – 26	Reserved		

8.2.1 Format identifier

The format identifier for the vascular biometric image standard record shall consist of the three ASCII characters “VIR” followed by a null character (0x00).

This BDB format is to be identified externally in accordance with ISO/IEC 19785-1: the format owner shall be set to 257 (ISO/IEC JTC1/SC37) and the format type shall be set to decimal 20, hex 0014 (vascular image data).

8.2.2 Version number

The number for the version of this standard used for constructing the image record shall be placed in four bytes. This version number shall consist of three ASCII numerals followed by a zero byte as a NULL string terminator. The first and second characters will represent the major version number, while the third character will represent the minor revision number. The current version number shall be 010 indicating the version 1 with no revision.

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8.2.3 Record length

The combined length in bytes for the entire record shall be recorded in these four bytes. This count shall be total length of record block including record header and image headers.

8.2.4 Capture device ID

The capture device ID shall be recorded in two bytes. A value of all zeros shall be acceptable and will indicate that the device ID is unreported. The vendor determines the value for this field. Application developers may obtain the values for these codes from the respective vendors.

8.2.5 Number of images

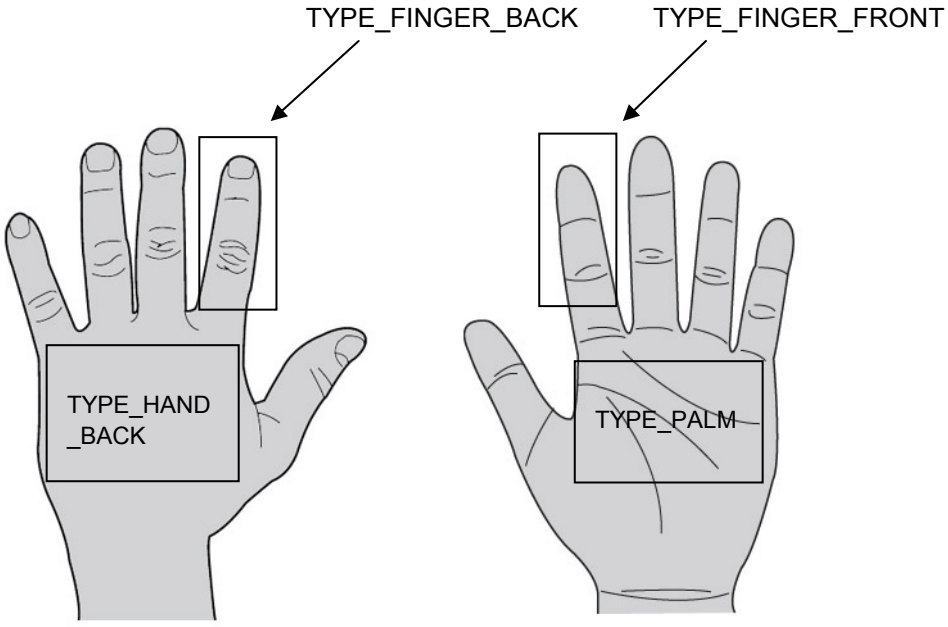
The number of vascular images included in the data block shall be recorded in two bytes. It is required that all images in a single vascular image data block be from the same imaging device. If two images are captured by two different devices with different capture device IDs, they shall be stored in separate data blocks, not in the same block.

8.3 Vascular image header

Each image contained in the vascular image data block is associated with a vascular image header describing individual image-specific information. The header structure is summarized in Table 3.

8.3.1 Image type

This field specifies various body locations where vascular images have been captured. The following figure shows several examples of image location on the hands.



TYPE _HAND_BACK:	The image is a scan of back of the hand.
TYPE _PALM:	The image is a scan of palm.
TYPE_FINGER_FRONT	The image is a scan of finger from frontal side
TYPE_FINGER_BACK	The image is a scan of finger from back side

Figure 4 — Image type specification

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8.3.2 Vascular image record length

This four-byte field shall specify the total length of the image block including the image header and data.

8.3.3 Image width and height

These two fields specify the horizontal and vertical image size in pixels, in two bytes for each field. If the image is compressed, these fields may contain the value IMAGE_WIDTH_UNDEF (0x0000).

8.3.4 Gray scale depth

This field represents the number of bits per pixel in a gray scale image or the number of bits per color per pixel in an RGB image. In compressed images, this field has the value GRAY_DEPTH_UNDEF (0x0000).

8.3.5 Image position and property bit field

This field is a mandatory field specifying the position, direction, and properties of the object. The first two bits specify the direction of organ (toward the left or the right). If the image type is “finger”, then bits 3 through 5 specify which finger is captured among the thumb, index, middle, ring, or little finger. Bit 6 and 7 specifies whether the image has been captured by transparent or reflectance illumination. Bits 8 through 10 specify if the contained image is flipped or not, and if flipped how the image has been flipped.

8.3.6 Rotation angle

This field is optional, which may specify the rotation angle of the image around the z-axis in the object coordinate system. The unit is degree normalized to 16-bit signed integer as (unsigned short) round (65536*(angle%360) /360).

8.3.7 Image format

This two-byte field specifies whether the image is monochrome or color and how the image has been compressed if applicable. Currently allowed compression standards are JPEG, JPEG_LS, and JPEG2000.

8.3.8 Illumination type

This field is an informative optional field that specifies the capture device’s illumination source. The defined types are near infrared (NIR), midrange infrared (MIR), and visible light source. The type of illumination shall be categorized based on the wavelength of illumination source; that is, the wavelength of visible illumination is in the range of 400 nm through 750 nm, the wavelength of NIR is in the range of 750 nm through 5,000 nm, and the wavelength of MIR is in the range of 5,000 nm through 25,000 nm.

8.3.9 Image background

This field specifies whether the background of the image has been processed or not. If the background has been processed and set to monotone, then this field shall have the value IMAGE_BACKGROUND_MONO (0x01); otherwise this field shall have the value IMAGE_BACKGROUND_UNDEF (0x00). Other valid values may be defined in future versions of this standard.

8.3.10 Horizontal scan resolution

This field specifies the scan resolution in the horizontal direction in ppcm. If the horizontal scan resolution is not specified, this field shall contain the value H_SCAN_RES_UNDEF= 0 (0x0000).

8.3.11 Vertical scan resolution

This field specifies the scan resolution in the vertical direction in ppcm. If the vertical scan resolution is not specified, this field shall contain the value V_SCAN_RES_UNDEF= 0 (0x0000).

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8.3.12 Pixel aspect ratio

This two-byte field specifies the pixel aspect ratio. The first byte specifies y distance and the second byte x distance. For example, 0x0304 means an aspect ratio of 3:4. If this field is undefined (0x0000), the default aspect ratio is assumed which is 1:1.

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Table 3 — Vascular image header

Bytes	Type	Content	Description
1-2	Unsigned short	Image type identifier	TYPE_UNDEF = 0 (0x00) TYPE _HAND_BACK = 1 (0x01) TYPE _PALM = 2 (0x02) TYPE _FINGER_BACK = 3 (0x03) TYPE_FINGER_FRONT = 4 (0x04)
3-6	Unsigned int	Record length	Total length of image block including image header and data
7-8	Unsigned short	Image width	Raw image width in pixels. If image is compressed, this field may be IMAGE_WIDTH_UNDEF = 0 (0x0000)
9-10	Unsigned short	Image height	Raw image height in pixels. If image is compressed, this field may be IMAGE_HEIGHT_UNDEF = 0 (0x0000)
11-12	Unsigned short	Gray scale depth	Gray scale depth per pixel; bits per color If image is compressed, this field may be GRAY_DEPTH_UNDEF = 0 (0x0000)
13 -14	Unsigned short	Image position and property bit field	1-2: Direction DIR_UNDEF = 0 DIR_RIGHT = 1 DIR_LEFT = 2 3-5: Finger index F_UNDEF = 0 F_THUMB = 1 F_INDEX = 2 F_MIDDLE = 3 F_RING = 4 F_LITTLE = 5 6-7: Imaging method IMAGING_UNDEF = 0 IMAGING_TRANSPARENCY = 1 IMAGING_REFLECTANCE = 2 8-10: Image flip FLIP_UNDEF = 0 FLIP_NONE = 1 FLIP_HORIZONTAL = 2 FLIP_VERTICAL = 3 FLIP_VERTICAL_HORIZONTAL = 4
15-16	Signed short	Rotation angle	Image rotation angle around the z-axis out of a standard pose. The unit is degree normalized to 16-bit unsigned integer, (unsigned short) round (65536*(angle%360)/360)

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17-18	Unsigned short	Image format and compression	Image type and compression format: IMAGE_COMP_UNDEF = 0 (0x00) IMAGE_MONO_RAW = 1 (0x0001) IMAGE_RGB_RAW = 2 (0x0002) IMAGE_MONO_JPEG = 3 (0x0003) IMAGE_RGB_JPEG = 4 (0x0004 IMAGE_MONO_JPEG_LS = 5 (0x0005) IMAGE_RGB_JPEG_LS = 6 (0x0006) IMAGE_MONO_JPEG2000 = 7 (0x0007) IMAGE_RGB_JPEG2000 = 8 (0x0008) IMAGE_MULTI_JPEG2000 = 9 (0x0009)
19	Unsigned char	Illumination type	The illumination type shall be one or a combination of the following: ILLUM_UNDEF = 0 (0x00) ILLUM_NIR = 1 (0x01) ILLUM_MIR = 2 (0x02) ILLUM_VISIBLE = 4 (0x04) ILLUM_OTHERS = 128 (0x80) If applicable, two or more illumination types may be specified by ORing constants.
20	Unsigned char	Image background definition	The flag to indicate background definition. If the background is processed and set to monotone, this field shall be set to IMAGE_BACKGROUND_MONO; otherwise this field shall have the value IMAGE_BACKGROUND_UNDEF (0x00). IMAGE_BACKGROUND_UNDEF = 0(0x00) IMAGE_BACKGROUND_MONO = 1(0x01)
21-22	Unsigned short	Horizontal scan resolution	Horizontal scan resolution in ppcm H_SCAN_RES_UNDEF= 0 (0x0000)
23-24	Unsigned short	Vertical scan resolution	Vertical scan resolution in ppcm V_SCAN_RES_UNDEF= 0 (0x0000)
25-26	Unsigned short	Pixel aspect ratio	Pixel aspect ratio. The first byte specifies y distance and the second byte x distance. For example, 0x0304 means an aspect ratio of 3:4. If this field is undefined (0x0000), the default aspect ratio is assumed which is 1:1. ASPECT_RATIO_UNDEF = 0 (0x0000)
27-32	Reserved		

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8.3.13 Vascular image header constants

The significance of specific constants within the header structures are as follows:

— UNDEF – usage in any constant indicates that the parameter is undefined.

— TYPE_HAND_BACK – the location of the captured image is the back of a hand.

— TYPE_PALM – the location of the captured image is palm.

— TYPE_FINGER_BACK – the location of the captured image is the dorsal side of a finger.

— TYPE_FINGER_FRONT – the location of the captured image is the frontal side of a finger.

— DIR_RIGHT – the right hand is scanned. Applicable for finger, palm, and back of the hand scans.

— DIR_LEFT – the left hand are scanned. Applicable for finger, palm, and back of the hand scans.

— F_THUMB – identifies the scanned finger.

F_INDEX

F_MIDDLE

F_RING

F_LITTLE

— IMAGING_TRANSPARENCY – the type of imaging method is transparency imaging.

— IMAGING_REFLECTANCE – the type of imaging method is reflectance imaging.

— FLIP_NONE – horizontal or vertical orientation is not changed from the one imaged from standard pose.

— FLIP_HORIZONTAL – horizontal orientation is opposite from the one imaged from standard pose.

— FLIP_VERTICAL – vertical orientation is opposite from the one imaged from standard pose.

— FLIP_VERTICAL_HORIZONTAL – horizontal and vertical orientation is opposite from the one imaged from standard pose.

— IMAGE_MONO_RAW – the image is in raw format, with the width and height in pixels specified by the raw image width and height, respectively. This format has no header. Each pixel is one intensity value and the lowest address corresponds to the upper left corner of the image, in row-major order.

— IMAGE_RGB_RAW – the image is in raw format, with the width and height in pixels specified by the raw image width and height, respectively. This format has no header. Each pixel is at least three consecutive bytes, representing values of red, green, and blue intensity. The lowest address corresponds to the upper left corner of the image, row-major order.

— IMAGE_MONO_JPEG – the image is monochrome and compressed using the JPEG algorithm as specified in ISO/IEC 10918.

— IMAGE_RGB_JPEG – the image is color and compressed using the JPEG algorithm as specified in ISO/IEC 10918.

— IMAGE_MONO_JPEG_LS – the image is monochrome and compressed using the JPEG-LS algorithm as specified in ISO/IEC 14495.

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— IMAGE_RGB_JPEG_LS – the image is color and compressed using the PEG-LS lossless compression algorithm as specified in ISO/IEC 14495.

— IMAGE_MONO_JPEG2000 – the image is monochrome and compressed using the JPEG2000 algorithm as specified in ISO/IEC 15444.

— IMAGE_RGB_JPEG2000 – the image is color and compressed using the JPEG2000 algorithm as specified in ISO/IEC 15444.

— IMAGE_MULTI_JPEG2000 – the image has more than three channels (multi-channel) and compressed using the JPEG2000 algorithm as specified in ISO/IEC 15444.

— ILLUM_NIR – the image is captured utilizing near infrared illumination. The wavelength range of near infrared illumination is defined as 700 nm through 5,000 nm.

— ILLUM_MIR – the image is captured utilizing midrange infrared illumination. The wavelength range of midrange infrared illumination is defined as 5,000 nm through 25,000 nm.

— ILLUM_VISIBLE – the image is captured utilizing visible range illumination.

— ILLUM_OTHERS – the image has another illumination method other than defined above.

— IMAGE_BACKGROUND_MONO – the background of the image has been processed and set to monotone.

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Annex A
(informative)

A sample image data packet

Table A.1 — A sample vascular biometric image data block

Bytes	Value	Description
Vascular image record header		
1 - 4	56 49 52 00	'V' 'I' 'R' 0x00 (Vascular Image Record)
5 - 8	30 31 30 00	Format version (1.0)
9 - 12	00 01 00 3A	Entire record length
13 -14	00 00	Capture device ID unknown
15 - 16	00 01	One image is contained in the data block
17 - 26	xx ……. xx	Reserved field
Vascular image header		
27 - 28	00 01	The image type is the back of the hand
29 - 32	00 01 00 20	Total length of image block including header block;
33 - 34	01 00	Image width, 256 pixels
35 - 36	01 00	Image height, 256 pixels
37 - 38	00 08	8-bits per pixel gray level depth
39 - 40	00 C1	Right hand with reflectance illumination, image not flipped
41 - 42	00 00	Image not rotated
43 - 44	01	Monochrome raw image
45	01	Near infrared light source (illumination)
46	01	Image background has been processed to monotone
47- 48	00 00	Horizontal scan resolution not known
49 - 50	00 00	Vertical scan resolution not known
51 - 52	03 04	3:4 aspect ratio
53 - 58	xx ……. xx	Reserved field
59 - 65594	Image data	Image pixel data values in row major format

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