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AMENDMENT 2
2015-08-01

Information technology — Biometric data interchange formats —

Part 9: Vascular image data

AMENDMENT 2: XML Encoding and clarification of defects

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

Partie 9: Données d'images vasculaires

AMENDEMENT 2: Codage XML et précisions concernant les défauts

Reference number
ISO/IEC 19794-9:2011/Amd.2:2015(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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.

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).

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).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

Amendment 2 to ISO/IEC 19794-9:2011 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

Information Technology — Biometric data interchange formats — Part 9: Vascular image data

Amendment 2: XML Encoding and clarification of defects

Insert the following text into introduction:

Additionally, this part of the ISO/IEC standard supports both binary and XML encoding, to support a spectrum of user requirements. With XML, this part will meet the requirements modern IT architectures. With binary encoding this part will also be able to be used in bandwidth or storage constrained environments. Annex C specifies the schema that XML encoded vascular image records must conform to, and Annex D provides an example of a valid XML encoded vascular image record.

Replace the existing text in clause "2– Conformance" with the following:

A binary data record conforms to this part of ISO/IEC 19794 if it satisfies all the format requirements with respect to its structure, data values, relationships among its fields, and with respect to relations between its fields and the underlying input that are specified throughout clause 8 of this part of ISO/IEC 19794.

An XML document conforms to this part of ISO/IEC 19794 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 Annex C of this part of ISO/IEC 19794.

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 (ICS).

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 (ICS).

Biometric data interchange format conformance tests conform to this part of ISO/IEC 19794 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 assertions defined in Table A.2 of clause A.3 in conformity with the concept and rules set in ISO/IEC 19794-1:2011 AMD 1.

Implementations of this part of ISO/IEC 19794 tested according to the specified methodology shall be able to claim conformance only to those biometric data record (BDB) requirements specified in this part of ISO/IEC 19794 that are tested by the test methods established by this methodology.

Implementations of this part of ISO/IEC 19794 do not necessarily need to conform to all possible aspects of this part of ISO/IEC 19794, 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 Annex A of ISO/IEC 19794-1:2011 AMD 1 and Table A.1 of clause A.2 of this part of ISO/IEC 19794.

Insert the following text in the appropriate alphabetical order of Clause "3-- Normative reference":

- http://www.w3.org/XML/Schema

Add the following row to Table 10 of ISO/IEC 19794-9:2011:

39 (0027_{Hex})	XML-vascular-image	{iso(1) registration-authority(1) cbeff(19785) biometric-organization(0) jtc1-sc37(257) bdbs(0) XML-vascular-image(39)}

Replace Table A.1 with the following table. This table, A.1, may extend over multiple pages:

Table A.1 — Requirements of the Base Standard

Requirement ID	Reference in Base Standard	Requirement Summary	Level	Status	Applicability		IUT Support	Supported Range	Test Result
					Binary	XML			
R- 1	6.1	The quantities in all records and vascular biometric image elements (pixel data), if represented as multi-byte quantities, are represented in big-endian format.	1	M	Y	N		N/A	
R- 2	6.1	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.	3C	O-1	Y	N		N/A	N/T
R- 3	6.2	The scan sequence shall be raster scan order.	3C	O-1	Y	N		N/A	N/T
R- 4	7.1	The spatial sampling rate of the captured image shall be represented in terms of pixels per centimetre.	3C	O-1	Y	N		N/A	N/T
R- 5	7.2	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.	1	M	Y	Y		N/A	
R- 6	7.5	The captured image shall be an orthographic projection of the body area being imaged.	3C	O-1	Y	Y		N/A	N/T
R- 7	7.6.2	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.	3C	O-1	Y	Y		N/A	N/T

Table A.1 (*continued*) **— Requirements of the Base Standard**

Requirement ID	Reference in Base Standard	Requirement Summary	Level	Status	Applicability		IUT Support	Supported Range	Test Result
					Binary	XML			
R- 8	7.6.3	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.	3C	O-1	Y	Y		N/A	N/T
R- 9	7.6.4	Images captured with more than three sensing channels shall be stored in accordance with the JPEG2000 compression algorithm as specified in ISO/IEC 15444.	3C	O-1	Y	Y		N/A	N/T
R- 10	7.7	The location of human body used for imaging shall be specified in the format.	1	M	Y	Y		N/A	
R- 11	7.7	The direction (left/right) of hand and/or finger index (thumb, index, middle, ring, and little) shall be specified.	1	M	Y	Y		N/A	
R- 12	8.2.1	The format identifier shall be recorded in four bytes. The format identifier shall consist of three characters "VIR" followed by a zero byte as a NULL string terminator.	1	M	Y	N		N/A	
R- 13	8.2.2	The number for the version of that part of ISO/IEC 19794 used for constructing the BDIR 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 character will represent the major version number and the third character will represent the minor revision number. Upon approval of a specification, the initial version number will be “020” – Version 2 revision 0.	1	M	Y	N		N/A	
R- 14	8.2.3	The length (in bytes) of the entire BDIR shall be recorded in four bytes.	1	M	Y	N			
R- 15	8.2.3	This count shall be the total length of the BDIR including the general record header and one or more representation records.	2	M	Y	N			

Table A.1 (*continued*) **— Requirements of the Base Standard**

Requirement ID	Reference in Base Standard	Requirement Summary	Level	Status	Applicability		IUT Support	Supported Range	Test Result
					Binary	XML			
					Y	N			
R- 17	8.2.4	The total number of representation records contained in the BDIR shall be recorded in two bytes. A minimum of one representation is required.	2	M	Y	N			
R- 18	8.2.5	As this part of ISO/IEC 19794 does not support certifications this field shall be 00Hex.	1	M	Y	N			
R- 19	8.3.2	The representation-length field denotes the length in bytes of the representation including the representation header fields.	1	M	Y	N			
R- 20	8.3.2	This four-byte field shall contain the length in bytes of the vascular image.	2	M	Y	N			
R- 21	8.3.3	The date and time field within a representation header shall be stated 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.	1	M	Y	Y			
R- 22	8.3.4	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 00Hex indicates unknown or unspecified technology. See Table 4 for the list of possible values.	1	M	Y	N			
R- 23	8.3.5	The capture device vendor identifier shall identify the biometric organization that owns the product that created the BDIR. The capture device 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 capture device vendor is unreported.	1	O	Y	Y			

Table A.1 (*continued*) **— Requirements of the Base Standard**

Requirement ID	Reference in Base Standard	Requirement Summary	Level	Status	Applicability		IUT Support	Supported Range	Test Result
					Binary	XML			
R- 24	8.3.6	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. A value of all zeros shall indicate that the capture device type is unreported.	1	O	Y	Y			
R- 25	8.3.6	If the capture device vendor identifier is 0000Hex, then also the capture device type identifier shall be 0000Hex.	2	O	Y	N			
R- 26	8.3.7.1	This field is followed by the number of 5-byte Quality Blocks reflected by its value.	1	O	Y	N			
R- 27	8.3.7.1	A value of zero (0) means that no attempt was made to assign a quality score. In this case, no Quality Blocks are present.	2	O	Y	N			
R- 28	8.3.7.2	Quality score, as defined in ISO/IEC 29794-1, shall be a quantitative expression of the predicted verification performance of the biometric sample.	3C	O-1	Y	Y		N/A	N/T
R- 29	8.3.7.2	An entry of 255 shall indicate a failed attempt to calculate a quality score. This value of Quality Score is harmonized with ISO/IEC 19784-1, where 255 is -1.	1	O	Y	Y			
R- 30	8.3.7.3	Quality Algorithm Vendor ID shall be registered with IBIA or other approved registration authority as a CBEFF biometric organization.	3C	O-1	Y	Y		N/A	N/T
R- 31	8.3.7.3	A value of all zeros shall indicate that the value for this field is unreported.	1	O	Y	Y			
R- 32	8.3.7.4	Quality Algorithm ID may be optionally registered with IBIA or other approved registration authority as a CBEFF Product Code. Refer to CBEFF product registry procedures in ISO/IEC 19785-2. A value of all zeros shall indicate that the value for this field is unreported.	1	O	Y	Y			

Table A.1 (*continued*) **— Requirements of the Base Standard**

Requirement ID	Reference in Base Standard	Requirement Summary	Level	Status	Applicability		IUT Support	Supported Range	Test Result
					Binary	XML			
R- 33	8.3.9	These two fields specify the horizontal and vertical image size in pixels, in two bytes for each field.	1	M	Y	Y			
R- 34	8.3.10	This field represents the number of bits per pixel in a gray scale image or the number of bits per color component per pixel in an RGB image.	1	M	Y	Y			
R- 35	8.3.11	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).	1	M	Y	Y		N/A	
R- 36	8.3.12	The unit is degree normalized to 16-bit signed integer as (unsigned short) round (65536*(angle%360) /360).	1	O	Y	Y			
R- 37	8.3.13	This two-byte field specifies whether the image is monochrome or color and how the image has been compressed if applicable.	1	M	Y	Y			
R- 38	8.3.14	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.	1	O	Y	Y		N/A	
R- 39	8.3.15	If the background has been processed and set to monotone, then this field shall have the value IMAGE_BACKGROUND_MONO (01_{Hex}); otherwise this field shall have the value IMAGE_BACKGROUND_UNDEF (00_{Hex}).	1	M	Y	Y		N/A	
R- 40	8.3.16	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 (0000_{Hex}).	1	M	Y	Y		N/A	

Table A.1 (*continued*) **— Requirements of the Base Standard**

Requirement ID	Reference in Base Standard	Requirement Summary	Level	Status	Applicability		IUT Support	Supported Range	Test Result
					Binary	XML			
R- 41	8.3.17	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 (0000 Hex).	1	M	Y	Y		N/A	
R- 42	8.3.18	The first byte specifies y distance and the second byte x distance. For example, 0304Hex means an aspect ratio of 3:4. If this field is undefined (0000Hex), the default aspect ratio is assumed which is 1:1.	1	M	Y	Y		N/A	
R- 43	8.4.1	The size of this section shall be kept as small as possible, augmenting the image data stored in the standard image data section. More than one extended data area may be present for each vascular representation.	3C	O-1	Y	Y		N/A	N/T
R- 44	8.4.1	The extended data for each vascular representation shall immediately follow the standard image data for that vascular representation and shall begin with the Extended Data Block Length field.	1	M	Y	Y			
R- 45	8.4.2.1	All vascular records shall contain the extended data block length. This field will signify the existence of extended data. A value of all zeros (0000_{Hex}) will indicate that there is no extended data and that the file will end or continue with the next vascular representation. A nonzero value will indicate the length of all extended data starting with the next byte.	2	M	Y	Y			

Table A.1 (*continued*) **— Requirements of the Base Standard**

Requirement ID	Reference in Base Standard	Requirement Summary	Level	Status	Applicability		IUT Support	Supported Range	Test Result
					Binary	XML			
R- 46	8.4.2.2	This field shall have a length of two bytes. It shall identify the format of the extended data area when this area is present. A value of zero in both bytes is a reserved value and shall not be used. A value of zero in the first byte, followed by a non-zero value in the second byte, shall indicate that the extended data section has a format defined in this part of ISO/IEC 19794; currently, only segmentation, annotation, and comment formats are specified (refer to clauses 8.4.3, 8.4.4, and 8.4.5). A non-zero value in the first byte shall indicate a vendor-specified format with a code maintained by the vendor.	1	O	Y	Y			
R- 47	8.4.2.3	The length of the extended data section shall be recorded in four bytes. This value is used to skip to the next extended data type identification field if the matcher cannot decode or use this data. If the Extended Data Block Length for the finger representation is zero, indicating no extended data, this field shall not be present.	1	O	Y	Y			
R- 48	8.4.3	If the extended data type identification code is 0001_{Hex}, the extended data section contains segmentation.	2	O	Y	Y			
R- 49	8.4.3.1	This 1-byte field shall contain the number of vascular segments that follow.	2	O	Y	Y			
R- 50	8.4.3.2	Each vascular segment shall be defined by the number of points used to define the segment and the coordinates of each point.	3C	O-1	Y	Y		N/A	N/T

Table A.1 (*continued*) **— Requirements of the Base Standard**

Requirement ID	Reference in Base Standard	Requirement Summary	Level	Status	Applicability		IUT Support	Supported Range	Test Result
					Binary	XML			
R- 51	8.4.3.2.1	This field shall specify the number of points or vertexes used to enclose the segmented image. For a vascular segment defined by rectangle, this byte shall contain a value of "2" representing the upper left and lower right corners of the rectangle. For a vascular segment enclosed by an n-sided polygon, this byte shall contain "n" where "n" is between 3 and 99.	2	O	Y	Y			
R- 52	8.4.3.2.1	The order of the vertices shall be in their consecutive order around the perimeter of the polygon, either clockwise or counterclockwise. No two vertices may occupy the same location. The polygon side defined by the last subfield and the first subfield shall complete the polygon. The polygon shall be a simple, plane figure with no sides crossing and no interior holes. Each vertex of the rectangle or polygon shall be represented by a pair of coordinates.	3C	O-1	Y	Y		N/A	N/T
R- 53	8.4.3.2.2	Two bytes shall be used to contain the horizontal pixel offset to the right relative to the origin positioned in the upper left corner of the image.	1	O	Y	Y			
R- 54	8.4.3.2.3	Two bytes shall be used to contain the vertical pixel offset down relative to the origin positioned in the upper left corner of the image.	1	O	Y	Y			
R- 55	8.4.4	If the extended data type identification code is 0002_{Hex}, the extended data section contains annotation information.	1	O	Y	Y			
R- 56	8.4.4.1	This one-byte field shall contain the number of annotations that follow. Each annotation will consist of two information items.	1	O	Y	Y			
R- 57	8.4.4.2	This byte shall contain the code 01_{Hex} for an amputated hand and code 02_{Hex} for a bandaged or otherwise unable to capture vascular.	1	O	Y	Y			

Table A.1 (*continued*) **— Requirements of the Base Standard**

Requirement ID	Reference in Base Standard	Requirement Summary	Level	Status	Applicability		IUT Support	Supported Range	Test Result
					Binary	XML			
R- 58	8.4.5	If the extended data type identification code is 0003 Hex, the extended data section contains ASCII text information associated with the captured image or subject supplying the image. The comment is inputted by the individual generating the vascular record. A null terminator for the ASCII string is not necessary, as the length is provided.	1	O	Y	Y			

Rename the title of clause A.3 and Table A.2:

A.3 Table of Conformance Test Assertions for Binary Encoding

Table A.2 —Binary Encoding Test Assertions

Add the following clause A.4. Table, A.3, may extend over multiple pages:

A.4 Table of Conformance Test Assertions for XML Encoding

The specific test assertions required for conformance testing to this part of ISO/IEC 19794 are listed in Table A.3. The normative requirements of this part of ISO/IEC 19794 described in Table A.1 are referenced in Table A.3.

Table A.3 —XML Encoding Test Assertions

Test Number	Section	Requirement ID	Level	Field Name	Operator	Operand	Test Note	Status	IUT Support	Supported Range	Test Result
X1		R-13	1	VascularImage .Version.Major	EQ	4		M			
X2		R-13	1	VascularImage .Version.Minor	EQ	0		M			
X3	Representation element	R-22	1	VascularImage .RepresentationList.Representation.CaptureDevice.DeviceID.Organization	EQ	0 to 65535		M			

Table A.3 (*continued*) **—XML Encoding Test Assertions**

Test Number	Section	Requirement ID	Level	Field Name	Operator	Operand	Test Note	Status	IUT Support	Supported Range	Test Result
X4	Representation element	R-23	1	VascularImage.RepresentationList.Representation.CaptureDevice.DeviceID.Type	EQ	0 to 65535		M			
X5	Representation element	R-21	1	VascularImage.RepresentationList.Representation.CaptureDevice.Technology	EQ	0 to 256		M			
X6	Representation element	R-30	1	VascularImage.RepresentationList.QualityType.Algoritm.Organization	EQ	0 to 65535		O			
X7	Representation element	R-31	1	VascularImage.RepresentationList.QualityType.Algoritm.Id	EQ	0 to 65535		O			
X8	Representation element	R-28	1	VascularImage.RepresentationList.QualityType.Score	EQ	0 to 100, FFHex		O			
X9	Representation element	R-10	1	VascularImage.RepresentationList.ImageType	EQ	Undefined, Handback, Palm, Fingerback, Fingerfront		M			
X10	Representation element	R-5, R-33	1	VascularImage.RepresentationList.BitDepth	EQ	7 to 16		M			
X11	Representation element	R-11,R-34	1	VascularImage.RepresentationList.HandPosition	EQ	Undefined, Right, Left		M			
X12	Representation element	R-11,R-34	1	VascularImage.RepresentationList.FingerPosition	EQ	Undefined, Thumb, Index, Middle, Ring, Little		M			
X13	Representation element	R-11,R-34	1	VascularImage.RepresentationList.ImagingMethod	EQ	Undefined, Transparency, Reflectance		M			

Table A.3 (*continued*) **—XML Encoding Test Assertions**

Test Number	Section	Requirement ID	Level	Field Name	Operator	Operand	Test Note	Status	IUT Support	Supported Range	Test Result
X14	Representation element	R-11,R-34	1	VascularImage.RepresentationList.ImageFlip	EQ	Undefined, None, Horizontal, Vertical, Both		M			
X15	Representation element	R-35	1	VascularImage.RepresentationList.RotationAngle	EQ	0 to 65535		M			
X16	Representation element	R-36	1	VascularImage.RepresentationList.FormatAndCompression	EQ	Undefined, MonochromeRaw, RGBRaw, MonochromeJPEG, RGBJPEG, MonochromeJPEGLossless, RGBJPEGLossless, MonochromeJPEG2000, RGBJPEG20000		M			
X17	Representation element	R-37	1	VascularImage.RepresentationList.Illumination	EQ	Undefined, NIR, MIR, Visible		M			
X18	Representation element	R-38	1	VascularImage.RepresentationList.Background	EQ	Undefined, Monotone		M			
X19	Representation element	R-39	1	VascularImage.RepresentationList.HolizontalScanResolution	EQ	0 to 65535		M			
X20	Representation element	R-40	1	VascularImage.RepresentationList.VerticalScanResolution	EQ	0 to 65535		M			
X21	Representation element	R-41	1	VascularImage.RepresentationList.PixelAspectRatio.AspectY	EQ	0 to 65535		M			
X22	Representation element	R-41	1	VascularImage.RepresentationList.PixelAspectRatio.AspectX	EQ	0 to 65535		M			

Table A.3 (*continued*) **—XML Encoding Test Assertions**

Test Number	Section	Requirement ID	Level	Field Name	Operator	Operand	Test Note	Status	IUT Support	Supported Range	Test Result
X23	Representation element	R-20	1	VascularImage .RepresentationList.CaptureDateTime	EQ			M			
X24	Representation element	R-32	1	VascularImage .RepresentationList.Width	EQ	0 to 65535		M			
X25	Representation element	R-32	1	VascularImage .RepresentationList.Height	EQ	0 to 65535		M			
X26	Representation element	R-45 to R-57		(extended data)				O			

Insert the following text as a new Annex C normative clause:

Annex C
(normative)

XML schema definition

This annex defines the schema that shall be used to validate xml vascular image records encoded in an xml format.

```
<?xml version="1.0" encoding="utf-8" ?>
<!-- Permission is hereby granted, free of charge in perpetuity, to any person obtaining a
copy of the Schema, to use, copy, modify, merge and distribute free of charge, copies of
the Schema for the purposes of developing, implementing, installing and using software
based on the Schema, and to permit persons to whom the Schema is furnished to do so,
subject to the following conditions: THE SCHEMA IS PROVIDED "AS IS", WITHOUT WARRANTY OF
ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL
THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY,
WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION
WITH THE SCHEMA OR THE USE OR OTHER DEALINGS IN THE SCHEMA. In addition, any modified copy
of the Schema shall include the following notice: THIS SCHEMA HAS BEEN MODIFIED FROM THE
SCHEMA DEFINED IN ISO/IEC 19794-9, AND SHOULD NOT BE INTERPRETED AS COMPLYING WITH THAT
STANDARD -->
<xs:schema
    xmlns:cmn="http://standards.iso.org/iso-iec/19794/-1/ed-2/amd/2"
    xmlns="http://standards.iso.org/iso-iec/19794/-9/ed-2/amd/2"
    elementFormDefault="qualified"
    attributeFormDefault="unqualified"
    targetNamespace="http://standards.iso.org/iso-iec/19794/-9/ed-2/amd/2"
    xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:import schemaLocation="19794-1_ed2_amd2.xsd"
  namespace="http://standards.iso.org/iso-iec/19794/-1/ed-2/amd/2" />

  <xs:annotation>
    <xs:documentation>
```

```
      Editor Note: At the 10th Sc37 meeting the outer element for 19794-9 "Vascular image
data" is defined as "VascularImage".
    </xs:documentation>
  </xs:annotation>

  <xs:simpleType name="VascularCaptureDeviceTechnology">
    <xs:restriction base="xs:string">
      <xs:enumeration value="Unknown" />
      <xs:enumeration value="CMOS/CCD" />
    </xs:restriction>
  </xs:simpleType>

  <xs:complexType name="CaptureDeviceType">
    <xs:sequence>
      <xs:element name="DeviceID" type="cmn:RegistryIDType"/>
      <xs:element name="CertificationIDList" minOccurs="0">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="CertificationID" type="cmn:RegistryIDType"
maxOccurs="unbounded" />
          </xs:sequence>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="VascularCaptureDeviceType">
    <xs:complexContent>
      <xs:extension base="CaptureDeviceType">
        <xs:sequence>
          <xs:element name="Technology" type="VascularCaptureDeviceTechnology"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>

  <xs:simpleType name="VascularImageType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="Undefined" />
      <xs:enumeration value="Handback" />
      <xs:enumeration value="Palm" />
      <xs:enumeration value="Fingerback" />
      <xs:enumeration value="Fingerfront" />
    </xs:restriction>
  </xs:simpleType>

  <xs:simpleType name="VascularHandPositionType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="Undefined" />
      <xs:enumeration value="Right" />
      <xs:enumeration value="Left" />
    </xs:restriction>
  </xs:simpleType>

  <xs:simpleType name="VascularFingerPositionType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="Undefined" />
      <xs:enumeration value="Thumb" />
      <xs:enumeration value="Index" />
      <xs:enumeration value="Middle" />
      <xs:enumeration value="Ring" />
      <xs:enumeration value="Little" />
    </xs:restriction>
  </xs:simpleType>

  <xs:simpleType name="VascularImagingMethodType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="Undefined" />
```

```
      <xs:enumeration value="Transparency" />
      <xs:enumeration value="Reflectance" />
    </xs:restriction>
  </xs:simpleType>

  <xs:simpleType name="VascularImageFlipType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="Undefined" />
      <xs:enumeration value="None" />
      <xs:enumeration value="Horizontal" />
      <xs:enumeration value="Vertical" />
      <xs:enumeration value="Both" />
    </xs:restriction>
  </xs:simpleType>

  <xs:simpleType name="VascularImageFormatAndCompressionType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="Undefined" />
      <xs:enumeration value="MonochromeRaw" />
      <xs:enumeration value="RGBRaw" />
      <xs:enumeration value="MonochromeJPEG" />
      <xs:enumeration value="RGBJPEG" />
      <xs:enumeration value="MonochromeJPGLossless" />
      <xs:enumeration value="RGBJPGLossless " />
      <xs:enumeration value="MonochromeJPEG2000" />
      <xs:enumeration value="RGBJPEG2000" />
      <xs:enumeration value="MultichannelJPEG2000" />
    </xs:restriction>
  </xs:simpleType>

  <xs:simpleType name="VascularIlluminationType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="Undefine" />
      <xs:enumeration value="NIR" />
      <xs:enumeration value="MIR" />
      <xs:enumeration value="Visible" />
    </xs:restriction>
  </xs:simpleType>

  <xs:simpleType name="VascularBackgroundType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="Undefine" />
      <xs:enumeration value="Monotone" />
    </xs:restriction>
  </xs:simpleType>

  <xs:complexType name="VascularScanResolutionType">
    <xs:choice>
      <xs:element name="Value" type="xs:unsignedShort" />
      <xs:element name="Undefined" />
    </xs:choice>
  </xs:complexType>

  <xs:complexType name="VascularPixelAspectRatioType" >
    <xs:sequence>
      <!-- pixel aspect ratio is defined as y:x -->
      <xs:element name="AspectY" type="xs:unsignedByte" />
      <xs:element name="AspectX" type="xs:unsignedByte" />
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name=" VascularSegmentationType">
    <xs:sequence>
      <xs:element name="Coordinate" type="cmn:CoordinateCartesian2DShortType"
minOccurs="2" maxOccurs="unbounded" />
    </xs:sequence>
  </xs:complexType>
```