INTERNATIONAL STANDARD

ISO/IEC 19794-4

First edition
2005-06-01

Corrected version
2019-02

Information technology — Biometric data interchange formats —

Part 4: Finger image data

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

Partie 4: Données d'image du doigt

Reference number
ISO/IEC 19794-4:2005(E)

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

Published in Switzerland

Contents

Page

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 member 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 19794-4 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 Behavioural Data*

— *Part 8: Finger Pattern Skeletal Data*

— *Part 9: Vascular Data*

— *Part 10: Hand Geometry Silhouette Data*

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

— *Part 13: Voice Data*

— *Part 14: DNA Data*

This corrected version of ISO/IEC 19794-4:2005 incorporates the following corrections:

This corrected version contains the original content of ISO/IEC 19794-4:2005 and incorporates the Technical Corrigendum ISO/IEC 19794-4:2005/Cor 1:2011.

Introduction

In the forensic community, the capture and transmission of fingerprint images has been a common choice for the exchange of fingerprint information used by Automatic Fingerprint Identification Systems (AFIS) for the identification of individuals. However, little to no fingerprint information is being exchanged between equipment from different vendors in the biometric user verification and access community. This has been due in part to the lack of agreement between vendors on the amount and type of information to capture, the method of capture, and the information to be exchanged.

This part of the ISO/IEC 19794 standard is intended for those applications requiring the exchange of raw or processed fingerprint images that may not necessarily be limited by the amount of resources required for data storage or transmitting time. It can be used for the exchange of scanned fingerprints containing detailed image pixel information. This part of ISO/IEC 19794 can also be used to exchange processed fingerprint image data containing considerably fewer pixels per inch and/or a lesser number of greyscale levels. This is in contrast to other parts of ISO/IEC 19794 used for exchanging lists of fingerprint characteristics such as minutiae, patterns, or other variants. These formats require considerably less storage than a fingerprint image. However, by using any of the other parts of ISO/IEC 19794, information recorded in one standard format cannot be used by algorithms designed to operate with another type of information. In other words, minutiae data cannot be used by pattern matching algorithms and pattern data cannot be used by minutiae matching algorithms.

Although the minutiae, pattern, or other approaches produce different intermediate outputs, all must initially capture a reasonably high quality fingerprint image before reducing the size of the image (in bytes) or developing a list of characteristic data from the image. Use of the captured or processed image can provide interoperability among vendors relying on minutiae-based, pattern-based or other algorithms. As a result, data from the captured finger image offers the developer more freedom in choosing or combining matching algorithm technology. For example, an enrolment image may be stored on a contactless chip located on an identification document. This will allow future verification of the holder of the document with systems that rely on either minutiae based or pattern based algorithms. Establishment of an image-based representation of fingerprint information will not rely on pre-established definitions of minutiae, patterns or other types. It will provide implementers with the flexibility to accommodate images captured from dissimilar devices, varying image sizes, resolutions, and different grayscale depths. Use of the fingerprint image will allow each vendor to implement their own algorithms to determine whether two fingerprint records are from the same finger.

Information technology — Biometric data interchange formats —

Part 4: Finger image data

1 Scope

This part of the ISO/IEC 19794 standard specifies a data record interchange format for storing, recording, and transmitting the information from one or more finger or palm image areas within an ISO/IEC 19785-1 CBEFF data structure. This can be used for the exchange and comparison of finger image data. It defines the content, format, and units of measurement for the exchange of finger image data that may be used in the verification or identification process of a subject. The information consists of a variety of mandatory and optional items, including scanning parameters, compressed or uncompressed images and vendor-specific information. This information is intended for interchange among organizations that rely on automated devices and systems for identification or verification purposes based on the information from finger image areas. Information compiled and formatted in accordance with this part of the ISO/IEC 19794 standard can be recorded on machine-readable media or may be transmitted by data communication facilities.

2 Conformance

Systems claiming conformance with this part of the ISO/IEC 19794 standard shall be capable of encoding and decoding finger image data and the associated parameter data used in the transmitting and/or receiving of fingerprint images as defined by this part of the ISO/IEC 19794 standard. At a minimum, conformance shall require the ability to capture, exchange, and compare interoperable fingerprint image information.

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.

IAFIS-IC-0110 (V3). *WSQ Gray-scale Fingerprint Image Compression Specification* 1997

ISO/IEC/CD 19785-3, *Common Biometric Exchange Formats Framework (CBEFF) — Part 1: Data Element Specification*

ISO/IEC IS 15444, *JPEG 2000, Information Technology — Digital Compression and Coding of Continuous-Tone Still Images — Part 1: Requirements and Guidelines*

MTR 04B0000022 (Mitre Technical Report), Margaret Lepley, Profile for 1000ppi Fingerprint Compression, Version 1.1, April 2004. Available at: http://www.mitre.org/work/tech_papers/tech_papers_04/lepley_fingerprint/lepley_fingerprint.pdf

4 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

4.1
biometric sample
raw data representing a biometric characteristic of an end-user as captured by a biometric system

EXAMPLE The image of a fingerprint.

4.2
capture
the method of taking a biometric sample from an end user

4.3
core
the approximate center of a fingerprint image area

Note 1 to entry: The exact location of the core is generally placed near the topmost point of the innermost recurving ridgeline of the fingerprint provided there are no ridges inside the recurving ridge. For those instances where there are one or more ridges within the recurving ridge, the placement of the core will be dependent upon the specific combination of ridges.

4.4
fingerprint image area
the area of friction skin on the fleshy surface of a finger located horizontally between the two edges of the fingernail and vertically between the first joint and the tip of a finger. It contains a unique pattern of friction ridge and valley information commonly referred to as a “fingerprint”

4.5
friction ridge
the ridges present on the skin of the finger which makes contact with an incident surface under normal touch

4.6
grayscale
the method used to represent a continuous tone image that has only a single component or variable to represent each pixel; also referred to as monochrome or black and white

4.7
image resolution
the number of pixels per unit distance in the interchanged image

Note 1 to entry: This may be the result of processing a captured image. The original captured scanned image may have been subsampled, scaled, interpolated, or otherwise processed to produce a form for representing the ridge and valley structure areas of the fingerprint.

4.8
latent
an impression of a fingerprint image collected from an intermediate surface, rather than directly via a live scan capture device or a traditional inked fingerprint card

Note 1 to entry: The term latent print is generally used to describe any type of print found at the scene of a crime or on evidence associated with a crime.

4.9
live capture
the process of capturing a biometric sample through an interaction between and end user and a biometric system

4.10
pixel
a picture element – located on an n by m matrix of picture elements, where n is the horizontal component and m is the vertical component.

4.11
plain fingerprint image
image captured from a finger placed on a platen without any rolling movement – the center portion of a rolled image

4.12
rolled fingerprint image
image area captured that is located between the two edges of the fingernail. Acquired using a rolling motion from one edge of the fingernail to the other

4.13
scan resolution
the number of pixels per unit distance used by a sensor or scanning device to initially capture a fingerprint or palmprint image

4.14
swipe fingerprint image
a method of fingerprint collection where the finger is manually slid across a one-dimensional sensor resulting in multiple readings or partial impressions from the same fingerprint. These readings are then combined to produce an accurate two-dimensional image of the fingerprint

4.15
transaction
a command, message, or input record that explicitly or implicitly calls for a processing action. Information contained in a transaction shall be applicable to a single subject

4.16
valley
the area surrounding a friction ridge, which does not make contact with an incident surface under normal touch; the area of the finger image area between two frictions ridges

5 Abbreviated terms

ppcm pixels per centimetre

ppi pixels per inch

ppmm pixels per millimetre

6 Data conventions

6.1 Byte and bit ordering

Each item of information, field, or logical record shall contain one or more bytes of data. Within a record all 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 less significant bytes. The order for transmission shall also be the most significant byte first and 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 fixed-length unsigned integer quantities.

6.2 Scan sequence

It is not the purpose of this part of the ISO/IEC 19794 standard to specify the orientation of the finger (or palm), the method of scanning, or the order of scanning used to capture the image. However, each image as presented in accordance with this format standard shall appear to have been captured in an upright position and approximately centered horizontally in the field of view. The recorded image data shall appear to be the result of a scanning of a conventional inked impression of a fingerprint. The

scanning sequence (and recorded data) shall appear to have been from left-to-right, progressing from top-to-bottom of the fingerprint or palm print. Figure 1 illustrates the recording order for the scanned image. For the purpose of describing the position of each pixel within an image to be exchanged, a pair of reference axes shall be used. The origin of the axes, pixel location (0,0), shall be located at the upper left-hand corner of each image. The x-coordinate (horizontal) position shall increase positively from the origin to the right side of the image. The y-coordinate (vertical) position shall increase positively from the origin to the bottom of the image.

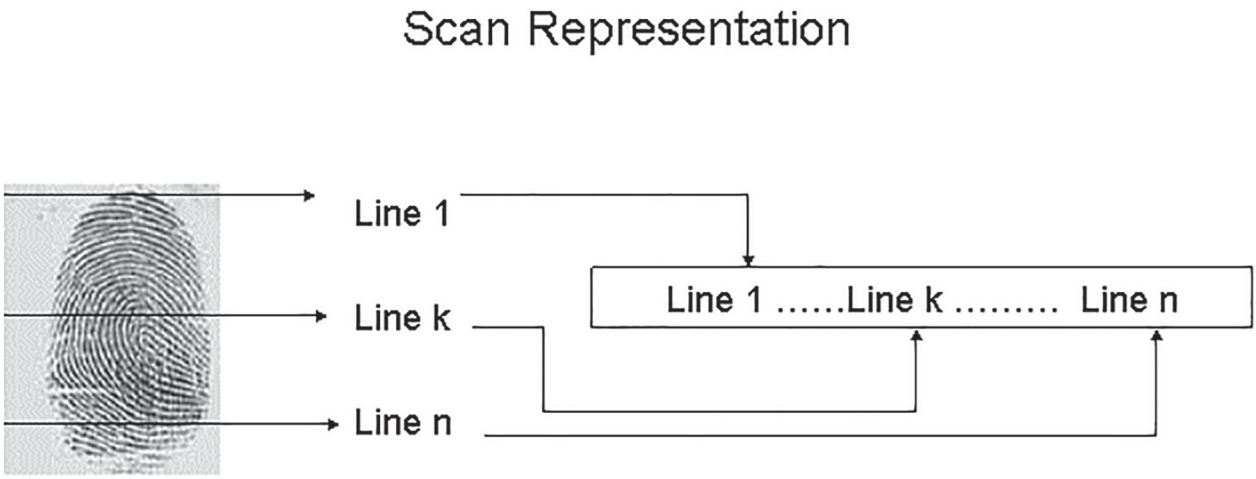

Figure 1 — Order of scanned lines

7 Image acquisition requirements

7.1 General

Image capture requirements are dependent on various factors including the application, the available amount of raw pixel information to retain or exchange, and targeted performance metrics. As a result of these factors, numeric values for specific image capture parameters will be associated with one of several combinations of image acquisition parameters settings. The choice of the image acquisition settings level should therefore be commensurate with the system and application requirements.

Table 1 lists the minimum requirements for selected image acquisition parameters as a function of the image acquisition settings level desired. A tolerance of plus or minus 1 % is applicable to the minimum numeric values stated for the scan resolution and dynamic range parameters. The last column indicates compliance with established certification procedures. Values for setting levels 40 or 41 are intended for applications requiring the greatest amount of detailed information. Scanners capable of level 30 and 31 performance are currently available and are being deployed for law enforcement purposes. Level 30 or 31 applications primarily include law enforcement agencies. Both level 41 and 31 systems should be certified using these and other requirements contained in Appendix F of the FBI's Electronic Fingerprint Transmission Specification (EFTS/F). Annex A lists the requirements from the EFTS/ Appendix F that are pertinent to fingerprint image input devices. The remaining levels are designed for commercial access control and verification systems. The overall quality level of a biometric system will be limited to that level at which all of the minimums are met.

NOTE Setting levels not listed are reserved for future definition by SC37, including indication of compliance with future ISO standards for image capture. Compliance with future certifications will be indicated by additional entries in the certifications columns.

7.2 Pixel aspect ratio

For all quality levels, the finger image shall be represented using square pixels, in which the horizontal and vertical dimensions of the pixels are equal. Any difference between these two dimensions should be within 1 %. That is, the ratio of horizontal to vertical pixel dimensions should be between .99 and 1. 01.

Table 1 — Image acquisition settings levels

Setting level	Scan resolution pixels/centimeter (ppcm)	Scan resolution pixels/inch (ppi)	Pixel depth (bits)	Dynamic range (gray levels)	Certification
10	49	125	1	2	None
20	98	250	3	5	None
30	197	500	8	80	None
31	197	500	8	200	EFTS/F
35	295	750	8	100	None
40	394	1000	8	120	None
41	394	1000	8	200	EFTS/F

NOTE Manufacturers generally express the rated scan resolution of their devices in pixels per inch (ppi). Table 1 also lists the resolutions in pixels per centimetre (ppcm). These are the rounded values of each ppi resolution divided by 2.54. The ppi and ppcm values are therefore consistent with, but not exactly equal to, each other. Either system may be used, but the two should not be intermixed or re-converted.

7.3 Pixel depth

The grayscale precision of the pixel data shall be specified in terms of the pixel depth or the number of bits used to represent the grayscale value of a pixel. A pixel depth of 3 provides 8 levels of grayscale; a depth of 8 provides up to 256 levels of gray. For grayscale data, the minimum value that can be assigned to a "black" pixel shall be zero. The maximum value that can be assigned to a "white" pixel shall be the grayscale value with all of its bits of precision set to "1". However, the 'blackest" pixel in an image may have a value greater than "0" and the "whitest" pixel may have a value less than its maximum value. This implies that the maximum value for a "white" pixel with 5 bits of precision shall be 31 or less. The maximum value for the "whitest" pixel using 8 bits of precision shall be 255 or less. The pixel depth may range from 1 to 16 bits.

7.4 Grayscale data

Grayscale finger image data may be stored, recorded, or transmitted in either compressed or uncompressed form. The image data portion of a record for an uncompressed grayscale image shall contain a set of raw pixel information. Using a pixel depth of 8 bits (256 grayscale levels) each pixel shall be contained in a single byte. Pixel values with a depth of less than eight bits can be stored and transmitted in a packed binary format. Increased precision for pixel values greater than 255 shall use two unsigned bytes to hold up to sixteen-bit pixels with values in the range of 0 to 65635. The encoding of a compressed grayscale image shall be the output of the appropriate grayscale compression algorithm specified. Upon decompression the grayscale value for each pixel shall be represented in the same manner as pixels in an uncompressed image.

7.5 Dynamic range

The image grayscale shall be encoded using the agreed precision necessary to meet the dynamic range requirement for a specific application. It is assumed that the precise requirements of the application are known.