ANSI/NIST-ITL 1-2007

DATA FORMAT FOR THE INTERCHANGE OF FINGERPRINT, FACIAL & SMT INFORMATION

INTERPOL IMPLEMENTATION

prepared by

The Interpol AFIS Expert Group

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GLOSSARY

AFR	Automatic Fingerprint Recognition
ANSI	American National Standards Institute
CRO	Criminal Record Office / Criminal Reference Number
FBI	Federal Bureau of Investigation
ISO	International Standards Organization
INT-I	Interpol Implementation
NIST	National Institute of Standards and Technology

ANSI/NIST STANDARD: DATA FORMAT FOR THE INTERCHANGE OF FINGERPRINT, FACIAL & SMT INFORMATION

Interpol Implementation

1 Introduction

In 1986 the American National Bureau of Standards published a standard to facilitate the interchange of fingerprint image information entitled "Data Format for the Interchange of Fingerprint Information" (ANSI/NBS-ICST 1-1986). Following a relatively exhaustive review procedure which included the UK Home Office and other US and Canadian law enforcement agencies, this was revised by the American National Institute of Standards and Technology (NIST) and issued as ANSI/NIST-CSL 1-1993. In 1997 the standard has been expanded to handle facial images and scar, mark and tattoo (SMT) image data. This expansion was issued as ANSI/NIST-ITL 1a-1997. In September 1998 both standards were revised and merged into the ANSI/NIST-ITL 1-2000 enhanced with additional field and record definitions.

As is often the case with standards such as these, it is defined fairly broadly so as to appeal to a large set of potential users. Hence, the standard provides some features not needed by some organizations. In addition, the standard also includes two user defined record types ("Type-2" and "Type-7") which are intentionally not defined within the standard, but rather are to be "user defined".

The latest ANSI/NIST-ITL 1-2007 standard is the result of agreements reached during two workshops held in April and December of 2005 to review the ANSI/NIST-ITL 1-2000 standard.

The present document, the Interpol Implementation (INT-I), has been written with the intention of supplementing the ANSI/NIST ITL 1-2007 publication for the guidance of members of the International Criminal Police Organization.

The INT-I has been drafted noting the following general points:

1. ***Openness***: The INT-I has been drafted to ensure openness and hence any subsequent systems using the INT-I are assured the highest level of inter-operability.

2. ***Non-intrusiveness:*** The INT-I has been drafted with a minimum level of mandatory requirements and many optional elements. There is no attempt to impose operational procedures and constraints on any system which conforms with the INT-I.

3. ***Inter-operability:*** The INT-I allows for the transfer of fingerprint information between different systems. However, in a situation where there is an incompatibility between the two (transmitter and receiver), it is the responsibility of the transmitter to ensure that the transmitted data is re-formatted to comply with the receiving system.

4. ***Wide usage:*** The INT-I has been designed to encompass the exchange of a wide variety of fingerprint information, and not just that required by an AFR system. For example, it is

envisaged that the INT-I could be used to transfer information such as the impressions from wrists and toes.

It should be noted that the records described in the ANSI/NIST standard and INT-I are not intended for manual entry and interpretation: rather they are intended for transmission of information between computers.

It is also important to note that some TOTs, and fields within records, may not be appropriate for certain transactions between particular agencies. For example, many agencies may not allow a remote site to add a record to its database, or there may be national legal objections to sending respondent images over a wide area network before they had been verified. However, in the spirit of open standards, and with the aim of excluding only the absolute minimum of information exchange, all such transactions are specified in INT-I but with the expectation that they would be blocked by the systems involved.

The following section describes the general structure of the ANSI/NIST standard and goes on to describe the various record types (Type-1, Type-2 ...). In addition this section also details the use of each of the record types.

2 Transmitted data conventions

2.1 Fingerprint Ridge Representation

Ridges in fingerprint images shall be represented as “dark ridges” in either grayscale or binary image data.

2.2 Byte and bit ordering

Each information item, subfield, field, and logical record shall contain one or more bytes of data. Within a file, the order for transmission of both the ASCII and the binary representations of bytes shall be most significant byte first and least significant byte last otherwise referred to as Big- Endian format. Within a byte, the order of transmission shall be the most significant bit first and the least significant bit last. Figure 1 illustrates the order of transmission of the bytes and bits within a file.

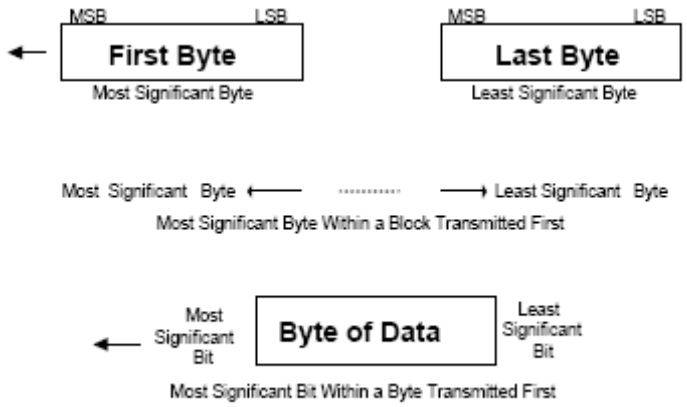

Figure 1 Byte and bit ordering

2.3 Grayscale data

Depending on the record type, grayscale image data may be transmitted in either compressed or uncompressed form. The transmission of uncompressed grayscale images shall consist of pixels, each of which shall normally be quantized to eight bits (256 gray levels) and held in a single unsigned byte. Increased precision for pixel values greater than 255 shall use two unsigned bytes to hold sixteen-bit pixels with values in the range of 0-65635. For grayscale data, a true black pixel shall be represented by a zero. A true white pixel shall have all of its bits of precision set to “1”. Therefore, true white pixels quantized to eight bits shall have a value of “255”, while a value of “1023” shall be used for pixels quantized to ten bits. As explained in 2.2, grayscale values requiring less than 8 or 16 bits are expressed as one or two bytes, right justified and zero padded on the left.

The transmission of compressed grayscale images shall be the output of the appropriate grayscale compression algorithm specified. Upon reconstruction of a compressed image the

grayscale value for each pixel shall be the same (for lossless algorithms) or nearly the same (for lossy algorithms) as pixels in an uncompressed image.

2.4 Binary data

Binary image data may be transmitted in either compressed or uncompressed form. The transmission of uncompressed binary images shall consist of pixels, each of which shall be quantized to one of two levels (binary representation). A value of zero shall be used to represent a white pixel and a value of one shall be used to represent a black pixel. For transmission of uncompressed binary images, eight pixels shall be left justified and packed into a single unsigned byte. The most significant bit of the byte shall be the first of the eight pixels scanned.

2.5 Color data

It is assumed that the scanned images consist of nominal 24 to 48-bit RGB pixels for color facial, SMT, iris, or user-defined testing images. Color image data may be transmitted in either compressed or uncompressed form. The transmission of uncompressed color images shall consist of RGB pixels, each component of which shall be quantized to at least 256 levels (8 bits). For each pixel, the three components shall be sequentially formatted for transmission on a pixel-by-pixel basis.

2.6 Compression algorithms

2.6.1 Color and grayscale compression algorithms

Compressed image data shall adhere to the requirements of the algorithm used. Table 1 lists the binary (shown here in base 10) and ASCII codes to be used for the available compression methods for encoding grayscale and color images described by this standard. But the choice of compression algorithms is limited by the type of data being exchanged (fingerprint, face, etc.). The description for each type of data exchange lists the legitimate compression algorithms that can be used for that type and whether a binary or ASCII code should be used.

Algorithm Name	Binary Code (in base 10)	ASCII Code
Uncompressed	0	NONE
WSQ Version 2.0	1	WSQ20
JPEG ISO/IEC 10918 (Lossy)	2	JPEGB
JPEG ISO/IEC 10918 (Lossless)	3	JPEGL
JPEG 2000 ISO/IEC 15444-1 (Lossy)	4	JP2
JPEG 2000 ISO/IEC 15444-1 (Lossless)	5	JP2L
Portable Network Graphics	6	PNG

Table 1 Grayscale & color image compression codes

The *"JPEGB"* algorithm indicates that the scanned or captured image was compressed using baseline JPEG. An entry of *"JPEGL"* indicates that the lossless mode of the JPEG algorithm was used to compress the image. If the image is captured in grayscale, then only the luminance

component will be compressed and transmitted. For JPEG, the data shall be formatted in accordance with the JPEG File Interchange Format, Version 1.02 (JFIF) as found in Appendix 4.

An entry of *"JP2"* indicates that the scanned or captured image was compressed using lossy JPEG 2000. (Conformance with ISO 15444-1 is provided through part 4 of the standard, ISO 15444-4 “Conformance Testing”.) An entry of *"JP2L"* indicates that the lossless mode of the JPEG 2000 algorithm was used to compress the image. For JPEG 2000, the data shall be formatted in conformance with JP2 format as described in ISO 15444-1.

Where JPEG 2000 is used for the compression of fingerprint images, specification/options contained in *Profile for 1000ppi Fingerprint Compression* (as listed in Section 3, Normative References) shall apply. This reference addresses the 9 quality layers between 0.015 bpp and 0.55 bpp.

Where JPEG 2000 is used for compression of facial images, the following conditions shall apply:

- Filters: The 9-7 irreversible filters described in ISO 15444-1 should be used for lossy mode; however for handheld devices (fixed point processors), the 5-3 reversible filters may be used instead. The 5-3 reversible filters shall be used for lossless mode. A conformant decoder shall be able to decode code streams created through both filters.
- Number of resolution levels: The image shall be encoded using enough resolution levels to ensure that a thumbnail with max(width, height) <= 64 is available in the image. Example: a 640x480 image shall be encoded with 5 resolution levels, which enables sub-resolution decodes of 320x240, 160x120, 80x60, and 40x30.
- Resolution as the dominant progression: JPEG 2000 allows five progression orders - LRCP, RLCP, RPCL, PCRL and CPRL. The RLCP progression order (resolution, layer, component, position) shall be used since it best facilitates decode and display of lower resolution derivative images by remote networked devices. Through the RLPC progression order, the code stream shall be formatted so that the resolution information of the image is the first data made available to a decoder in a streaming mode of operation.
- Bits per Channel: The number of bits per channel for encoders and decoders shall be 8-16 bits.
- Single tile images: Facial images shall be encoded using only single tile to avoid tiling artifacts.
- JPEG 2000 quality layers: The image shall be encoded using at least 10 quality layers to enable quality progressive decoding or sub-quality image extraction.

Region of Interest (ROI) Encoding is allowed: This encoding method is a useful way to compress a facial image to a small size, while retaining sufficient image quality within the specified ROI to perform either human or automated identification.

2.6.2 Binary compression algorithms

Table 2 lists the binary codes for the available compression schemes that can be used for encoding binary image data described by this standard. This standard does not use ASCII codes for describing compression methods for the exchange of binary images.

Algorithm Name	Binary Code	ASCII Code	Notes
Uncompressed	0		Image Packed 8 pixels/byte
Facsimile ANSI/EIA 538-1988	1		Lossless

Table 2 Binary compression codes

The transmission of compressed binary images shall be the output of the binary compression algorithm specified by ANSI/EIA-538-1988. Upon decompression, each pixel with a value of zero shall be considered to be white and each pixel with a value of one shall be considered to be black.

2.7 Color spaces

Table 3 lists the codes and their descriptions for each of the available color spaces used within this standard. All other color spaces are to be marked as undefined.

Code	Description
UNK	Undefinied
GRAY	Grayscale (monochrome)
RGB	Undetermined color space for an RGB image
SRGB	sRGB (IEC 61966-2-1)
YCC	YCbCr (legacy)
SYCC	YCbCr (JPEG 2000 compressed)

Table 3 Color spaces

2.7.1 Backwards compatibility

In previous versions of this standard, the term “color space” referred to device-dependent color information with a particular sequence and range for the three color channels. The choice was either RGB or an RGB-derivative space known as YCC. Neither space provides an objective definition of a particular color or relates to the way in which humans perceive color.

Although sRGB is the preferred color space for compressed images for this version, in the previous version of this standard, it was stated that “the preferred color space for compressed images using baseline JPEG and JFIF is YCbCr to be coded as 8YCC’,” while the color space for uncompressed color images was to be labeled RGB. Therefore, for backwards compatibility purposes, new systems must accommodate JPEG images that have been labeled as using the YCC color space. Specifically, systems conformant with this standard must accept an entry of YCC and interpret it as meaning a (device-dependent) RGB color space.

2.7.2 Color space sRGB

To ensure that color images exchanged between differing systems can be correctly displayed or printed, images should be converted to the device-independent color space, sRGB11, before compression or transmission to another system. As defined by IEC 61966-2-1, sRGB is a nonlinear display profile that accommodates the voltage-to-color response characteristics of

most high quality CRT monitors. The colors of the red, green, and blue phosphors (primaries) and the white point setting of an sRGB-conformant monitor are specified in the IEC document.

The relationship between sRGB and a linear RGB space having the IEC-defined primaries and white point is as follows:

$$value_{sRGB} = \begin{cases} 12.92 value_{lin}, & \text{for } value_{lin} \le 0.0031308 \\ 1.055 value_{lin}^{(1/2.4)} - 0.055, & \text{for } value_{lin} > 0.0031308 \end{cases}$$

Where $value_{lin}$ is an R, G or B value in linear RGB space (with a range of 0 to 1) and $value_{sRGB}$ is the corresponding R, G or B value in non-linear *sRGB* space (also with a Range of 0 to 1). To convert from/to the range of 0 to 255, divide/multiply by 255.

Typically, modern digital cameras, desktop scanners, LCD monitors, and printers, although they don't inherently operate in sRGB space, are designed with circuitry or software to produce sRGB output or to accommodate sRGB as an input space. If an image acquisition device's color space is unknown, sRGB is usually a reasonable choice. If an acquisition device and its software cannot provide sRGB output, various color management products are available commercially that use its color profile, often available from its manufacturer, to convert images in its native color space to sRGB.

2.8 Scan sequence

Each color, grayscale, or binary image formatted in accordance with this 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 or photo of a face or iris. This is also equivalent to a live-scan capture of the finger, or a camera capture of a face or iris. The scanning sequence (and recorded data) shall appear to have been from left-to-right, progressing from top-to-bottom of the fingerprint, palm print, face, SMT, or iris. Figure 2 illustrates the recording order for the scanned fingerprint 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.

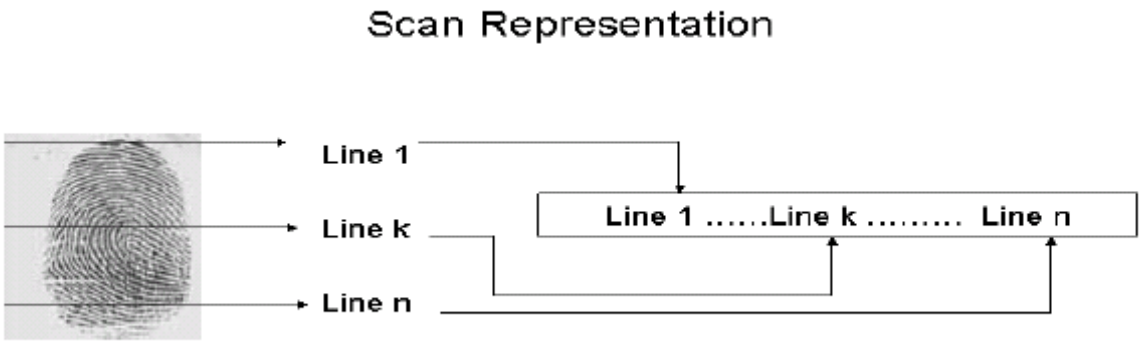

Figure 2 Order of scanned image

3 Image resolution requirements

Image resolution requirements are applicable to fingerprint, palmprint, and signature images. Facial/mugshot, SMT, and iris images rely on the total number of pixels scanned and transmitted and are not dependent on the specific scanning resolution used.

3.1 Scanner resolution requirement

Binary and grayscale fingerprint images to be exchanged shall be captured by an AFIS, live-scan reader, or other image capture device operating at a specific native scanning resolution. The minimum scanning resolution for this capture process shall be 19.69 ppmm plus or minus 0.20 ppmm (500 ppi plus or minus 5 ppi). Scanning resolutions greater than this minimum value and with a device tolerance of plus or minus 1% may be used. Although a minimum scanning resolution is specified, a maximum value for scanning resolution is not specified by this standard**.**

However, for latents images, the minimum scanning resolution (or effective scanning resolution) and transmission rate for latent images shall be 39.37 ppmm plus or minus 0.40 ppmm (1000 ppi plus or minus 10 ppi).

The recommended migration path to higher scanning resolutions for image capturing devices with a native scanning resolution of 19.69 ppmm (500 ppi) shall be at a rate of 100% of the current native scanning resolution. The recommended migration path progresses from 19.69 ppmm to 39.37 ppmm (500 ppi to 1000 ppi), from 39.37 ppmm to 78.74 ppmm (1000 ppi to 2000 ppi), etc. Capture devices with native scanning resolutions not in step with this migration path shall provide (through subsampling, scaling, or interpolating downward) an effective scanning resolution that matches the next lower interval in the migration path. For example a device with native scanning resolution of 47.24 ppmm (1200 ppi) shall be required to provide an effective resolution of 39.37 ppmm (1000 ppi).

3.2 Transmitting resolution requirement

Each image to be exchanged shall have a specific resolution associated with the transmitted data. This transmitting resolution does not have to be the same as the scanning resolution. However, the transmitting resolution shall be within the range of permissible resolution values for that record type. When an image is captured at a scanning resolution greater than the permissible upper limit of the transmitting resolution for that record type, the image shall be subsampled, scaled, or interpolated down. This processing to reduce the scanning resolution to a lower effective resolution must be performed before the transmission occurs.

For high-resolution binary and grayscale images, the preferred transmitting resolution shall be the same as the minimum scanning resolution of 19.69 ppmm plus or minus 0.20 ppmm (500 ppi plus or minus 5 ppi). Any transmitting resolution within the range of the minimum scanning resolution to a value of 20.47 ppmm plus or minus 0.20 ppmm (520 ppi plus or minus 5 ppi) is permitted for the processing of high-resolution records.
For low-resolution binary and grayscale images, the preferred transmitting resolution shall be half of the minimum scanning resolution or 9.84 ppmm plus or minus 0.10 ppmm (250 ppi plus or minus 2.5 ppi). Any transmitting resolution within the range of half of the minimum scanning resolution to a value of 10.24 ppmm plus or minus 0.10 ppmm (260 ppi plus or minus 2.5 ppi) is permitted for the processing of low-resolution records.

For variable-resolution images, the preferred transmitting resolution is not specified, but must be at least as great as the high-resolution rate of 19.69 ppmm. At this time there is no upper limit on the variable-resolution rate for transmission. However, the recommended migration path to higher transmitting resolutions is the same as for the scanning resolutions. That is, to progress from 19.69 ppmm to 39.37 ppmm plus or minus 1% (500 ppi to 1000 ppi), from 39.37 ppmm to 78.74 ppmm plus or minus 1% (1000 ppi to 2000 ppi), etc. For images captured at a native scanning resolution greater than the permissible upper limit of a transmitting resolution step in the migration path, it may be necessary to subsample, scale, or interpolate down. The result of this processing is to obtain an effective scanning resolution that conforms to a step in the transmission migration path.

The transmitting resolution shall be contained in fields specified by the format for the variable-resolution record. However, before transmitting variable-resolution records, the operational capabilities of the sending and receiving systems should be addressed, and prior agreement should be made with the recipient agency or organization before transmitting the image.

4 File description

This standard defines the composition of a transaction file that is transmitted to a remote site or agency. As specified in this standard, certain portions of the transmission shall be in accordance with definitions provided by the receiving agency. This file shall contain one or more logical records each corresponding to one of the defined available types. The logical records are intended to convey specific types of related information pertinent to the transaction itself or to the subject of the transaction. All of the logical records belonging to a single transaction shall be contained in the same physical file.

The standard defines three logical records for the exchange of ASCII textual information fields, six logical records for the exchange of binary information and seven tagged-field record types designed for the exchange of a combination of ASCII and image data within a single logical record structure. These tagged-field records consist of ASCII tagged textual fields and binary,

grayscale, or color image data. At the beginning of the record, a series of tagged fields shall be used to provide information required for processing the image data present in the last field of the logical record.

Two additional record types are reserved for inclusion in future revisions of this standard. The sixteen defined types of logical records together with the identifier for each type are listed in Table 4.

Record Identifier	Logical record contents	Type of data
1	Transaction information	ASCII
2	User-defined descriptive text	ASCII
3	Low-resolution grayscale fingerprint image	Binary
4	High-resolution grayscale fingerprint image	Binary
5	Low-resolution binary fingerprint image	Binary
6	High-resolution binary fingerprint image	Binary
7	User-defined image	Binary
8	Signature image	Binary
9	Minutiae data	ASCII
10	Facial & SMT image	ASCII/Binary
11	Reserved for future use	-
12	Reserved for future use	-
13	Variable-resolution latent image	ASCII/Binary
14	Variable-resolution fingerprint image	ASCII/Binary
15	Variable-resolution palmprint image	ASCII/Binary
16	User-defined variable-resolution testing image	ASCII/Binary
17	Iris image	ASCII/Binary
18-98	Reserved for future use	ASCII/Binary
99	CBEFF Biometric data record	ASCII/Binary

Table 4 Logical record types

4.1 File format

A file shall contain one or more logical records pertaining to a single subject. The data in the Type-1 record shall always be recorded in variable length fields using the 7-bit American National Standard Code for Information Interchange (ASCII) as described in ANSI X3.4-1986 and Annex A. For purposes of compatibility, the eighth (leftmost) bit shall contain a value of zero.

The text or character data in the Type-2, Type-9, and tagged-field records will normally be recorded using the 7-bit ASCII code in variable-length fields with specified upper limits on the size of the fields. For data interchange between non-English speaking agencies, character sets other than 7-bit ASCII may be used in textual fields contained in the Type-2, Type-9, and tagged-field records. UTF-8 is the preferred method of storing textual data that cannot be represented as 7-bit ASCII. This method supports international character sets for all user-defined fields in all record types. The mechanism to change character sets is described in Section 8.2.3, International Character Sets. By definition UTF-8 and other international character exchange methods are not applicable to record Type 1 and Types 3-8.

The first field in all tagged-field records shall be labeled as field "1" and contain the length in bytes of the record. The second field shall be labeled as field "2" and contain the image designation character as described in Section 7.4. The remaining textual fields may occur in any order and contain the information as described for that particular numbered field. For tagged field image records, Type-10 through Type-17 and Type-99, the last and concluding field shall have a tagged ASCII field number identifier "999" followed by the image data.

For the binary image Type-3, Type-4, Type-5, Type-6, and Type-8 logical records, the content and order of the recorded fields are specified by this standard. With the exception of the first two fields, the remaining fields of the Type-7 logical image record are all user-defined. All fields and data in these record types shall be recorded as binary information.

4.2 File contents

Files to be exchanged are required to contain one and only one Type-1 logical record per transaction. The Type-1 logical record shall always be the first logical record within the file. Depending on the usage and the number of fingerprint, palmprint, facial/mugshot, SMT, iris, or other biometric images available for processing, one or more additional records may be present in the file.

Table 5 lists the typical range or the number of records that may be contained in a file. These record counts are shown by logical record types for common processing functions used for search inquiries, file maintenance, image request, and image responses. The record limits stated in the table are examples of typical transactions and should only be interpreted as a guideline. Receiving agencies may impose their own specific limit for each type of logical record depending on the application. The ranges listed specify the minimum and maximum number of logical records that may be contained in the file. The mandatory inclusion of a logical record is indicated by an entry of "1" in the table. An entry of "0" indicates the exclusion of that logical record type. The appearance of "0-N" in the table indicates that the standard imposes no limits on the number of records for that logical record type. An entry of "1-N" requires that at least one record be present with no upper limit on the number of records that may be present.

4.3 Implementation domains

The Type-2 record is composed of user-defined textual fields. Many of the information fields in the Type-2 record are used in the same way by local, state, and Federal agencies and require the same data and formatting. In order to establish a common basis for field numbering, meaning, and formatting, jurisdictions that use the same general set of data fields may subscribe to a common implementation domain.

An implementation domain can be viewed as a group of agencies or organizations that have agreed to use specific pre-assigned groups of numbered tagged fields for exchanging information unique to their installations. Each tagged-field number shall also have a definition and format associated with it. The domain implementation name uniquely identifies field contents and avoids tag numbers with multiple Type-2 field definitions. Each domain created shall have a point of contact responsible for keeping the list of numbered tagged fields and assigning new numbered tagged fields to organizations within their domain. The contact shall serve as a registrar and maintain a repository including documentation for all the common and user-specific Type-2 fields contained in the implementation. As additional fields are required by

specific agencies for their own applications, new field tag numbers and definitions can be registered and reserved to have a specific meaning. When this occurs, the domain registrar is responsible for registering a single definition for each tagged-field number used by different members of the domain.

Type of logical record	Master file inquiry	Latent inquiry	File maintenance	Image request	Search response	Image request response
1	1	1	1	1	1	1
2	1-N	1-N	1-N	1	1	1
3	0-14	0	0-14	0	0-14	0-14
4	0-14	0-10	0-14	0	0-14	0-14
5	0-14	0	0-14	0	0-14	0-14
6	0-14	0-10	0-14	0	0-14	0-14
7	0	0-N	0-N	0	0-N	0-N
8	0-2	0	0-2	0	0-2	0-2
9	0-10	0-N	0-N	0	0	0
10	0-N	0-N	0-N	0	0-N	0-N
13	0	0-N	0-N	0	0-N	0-N
14	0-14	0	0-14	0	0-N	0-N
15	0-8	0-N	0-8	0	0-N	0-N
16	0	0	0-N	0	0-N	0-N
17	0-2	0	0-2	0	0-2	0-2
99	0	0	0-N	0	0-N	0-N

Table 5 Number of logical records per transaction

The Criminal Justice Information Services (CJIS) Division of the Federal Bureau of Investigation (FBI) has established and maintains the North American Domain subscribed to by the Royal Canadian Mounted Police (RCMP), the FBI, and several state and Federal agencies in North America. The registrar for this domain assigns and accounts for a set of tagged fields to be used by its clients during the processing of transactions. Other domains also exist including those maintained by the United Kingdom (UK) and Interpol. These organizations have developed their own Type-2 record implementations tailored to their specific communities.

4.4 Image designation character (IDC)

With the exception of the Type-1 logical record, each of the remaining logical records present in a file shall include a separate field containing the Image Designation Character (IDC). The IDC shall be used to relate information items in the file content field of the Type-1 record to each logical record, and to properly identify and link together logical records that pertain to the same entity such as a particular finger or face. The value of the IDC shall be a sequentially assigned positive integer starting from zero and incremented by one. If two or more logical records that are different representations of the same subject matter are present in a file, each of those logical records shall contain the same IDC. For example, a high-resolution image record of a specific fingerprint and the corresponding minutiae record for the same finger would carry the same IDC number.

Although there is no upper limit on the number of logical records that may be present in a file, generally a minimum of two and no more than 25 logical records will be present in a file. For example, a tenprint search inquiry transaction may consist of a Type-1 record, a Type-2 record,

14 high-resolution Type-4 or variable-resolution Type-14 grayscale image records, two Type-8 signature records, six Type-15 palmprint records, and a Type-10 facial/mugshot image of the subject. Additional mugshot, SMT, iris, or other biometric logical records may expand the file even more. For this file configuration, the IDC shall range from "0" to "24" which would include an IDC code for the Type-2 record. Within the same file, multiple logical record types may be present and represent the same image. For example, if core and delta location information for the rolled impressions is requested, the transmission may also need to accommodate ten minutiae records within the same file. For each image representing the ten finger positions, the same IDC would be used in both the image and minutiae records.

The IDC shall also be used to relate information items in the file contents field of the Type-1 record to each facial, SMT, iris, or other biometric image record. It properly identifies and links together different logical record types created from the same face/mugshot or SMT image.

Furthermore, zero or more Type-7 records may also be present. Each Type-7 logical record representing a specific sample shall have a unique IDC with an increment of one greater than the last IDC used.

5 Record description

5.1 Logical record types

A fingerprint file, as specified in the ANSI/NIST-ITL 1-2007 standard, consists of several logical records. There are sixteen types of record. Appropriate ASCII separation characters are used between each record and the fields and subfields within the records.

5.1.1 Type-1 Transaction information record

This record contains routing information and information describing the structure of the rest of the file. This record type also defines the types of transaction which fall under the following broad categories:

- ∉ ten-print services
- ∉ scene-of-crime services
- ∉ fingerprint image services and messaging
- ∉ scar, mark, tattoo and facial image services
- ∉ palm print services

It should be noted that the particular transaction types allowed in Section 1 are typical of the transactions carried out by Interpol members and may be different from those used elsewhere.

5.1.2 Type-2 User-defined descriptive text

Type-2 logical records shall contain user-defined textual fields providing identification and descriptive information associated with the subject of the transaction. Data contained in this

record shall conform in format and content to the specifications of the domain name as listed in Domain Name field found in the Type-1 record.

5.1.3 Type-3 Low-resolution grayscale fingerprint image

This record is used to exchange low resolution gray-scale (eight bit) fingerprint images sampled at 250 pixels/inch.

Records of this type will not be used by Interpol.

5.1.4 Type-4 High-resolution grayscale fingerprint image

This record is used to exchange high resolution gray-scale (eight bit) fingerprint images sampled at 500 to 520 pixels/inch. It is common practice to compress the fingerprint images using the WSQ algorithm. Other compression algorithms shall not be used.

5.1.5 Type-5 Low-resolution binary fingerprint image

This record is used to exchange low resolution binary fingerprint images sampled at 250 pixels/inch.

Records of this type will not be used by Interpol.

5.1.6 Type-6 High-resolution binary fingerprint image

This record is used to exchange high resolution binary fingerprint images sampled at 500 to 520 pixels/inch.

Records of this type will not be used by Interpol.

5.1.7 Type-7 User-defined image record

In earlier versions of this Implementation the type-7 record was intended for the exchange of fingerprint image data other than the conventional images of finger prints. At present the envisaged use is for the exchange of images such as soles and toes of feet, and also for sections of ten-print forms.

Starting with this version of INT-I the usage of Type-7 record for the exchange of latent and/or palmprint images is obsolete. To ensure backward compatibility the support of using Type-7 for latent and palmprint exchange shall be implemented in all newer systems too.

5.1.8 Type-8 Signature image record

This record is used to transmit the signature of the fingerprinting officer or the fingerprinted subject. The ANSI/NIST standard allows for the fingerprint image to be uncompressed binary, compressed binary or vectorized format.

5.1.9 Type-9 Minutiæ data record

Type-9 records are used to exchange ridge characteristics or minutiæ data. Their purpose is partly to avoid unnecessary duplication of AFR encoding processes and partly to allow the transmission of AFR codes which contain less data than the corresponding images.

5.1.10 Type-10 Facial and/or SMT image record

Type-10 records shall contain facial and/or SMT binary image data and related ASCII information pertaining to the specific image contained in this record. It shall be used to exchange both grayscale and color image data. Image data contained in the Type-10 record may be uncompressed or compressed.

5.1.11 Type-13 Variable-resolution latent image record

Type-13 tagged field image records shall be used to exchange variable-resolution latent fingerprint and latent palmprint images together with textural alphanumerical information. The scanning resolution of the images shall be 500 pixels/inch with 256 gray-levels. If the quality of the latent image is sufficient it shall be compressed using WSQ-algorithm. If necessary the resolution of the images may be expanded to more than 500 pixels/inch and more than 256 gray-levels on bilateral agreement.

5.1.12 Type-14 Variable-resolution fingerprint image record

Type-14 tagged-field image records shall contain and be used to exchange variable-resolution fingerprint image data, segmented flat fingerprint data, or major case print data. Fixed and userdefined textual information fields pertinent to the digitized image may also be included. Fingerprint images can be either rolled or plain (including swiped) impressions.

The scanning resolution is not specified for this record type. While the Type-14 record may be used for the exchange of 19.69 ppmm (500 ppi) images, it is strongly recommended that the minimum scanning resolution (or effective scanning resolution) for fingerprint images be 39.37 ppmm plus or minus 0.40 ppmm (1000 ppi plus or minus 10 ppi). It should be noted that as the resolution is increased, more detailed ridge and structure information becomes available in the image. However, in all cases the scanning resolution used to capture a fingerprint image shall be at least as great as the minimum scanning resolution of 19.69 ppmm (500ppi).

The variable-resolution fingerprint image data contained in the Type-14 logical record may be in a compressed form. Typically, there may be up to 14 of these Type-14 records in a file; ten rolled impressions of the individual fingers, two plain impressions of the thumbs or one plain impression of the two thumbs simultaneously, and two plain impressions of the four simultaneously obtained remaining fingers of each hand. The Type-14 record may be considered as the tagged-field variable-resolution version of the Type-4 record used for the exchange of rolled or flat fingerprint images.

5.1.13 Type-15 Variable-resolution palmprint image record

Type-15 tagged-field image records shall contain and be used to exchange variable-resolution palmprint image data together with fixed and user-defined textual information fields pertinent to the digitized image.

The scanning resolution is not specified for this record type. While the Type-15 record may be used for the exchange of 19.69 ppmm (500 ppi) images, it is strongly recommended that the minimum scanning resolution (or effective scanning resolution) for palmprint images be 39.37 ppmm plus or minus 0.40 ppmm (1000 ppi plus or minus 10 ppi). It should be noted that as the resolution is increased, more detailed ridge and structure information becomes available in the image. However, in all cases the scanning resolution used to capture a palmprint image shall be at least as great as the minimum scanning resolution of 19.69 ppmm (500ppi).

The variable-resolution palmprint image data contained in the Type-15 logical record may be in a compressed form. The maximum number of occurrences of these Type-15 records in a file is eight. Different combinations may include: two writer’s palms to pair with two full palmprints; a writer's palm with an upper and lower palm from each hand; or a writer's palm with the thenar, hypothenar and interdigital areas from each hand.

5.1.14 Type-16 User-defined variable-resolution testing image record

The Type-16 tagged-field image record is intended as the tagged-field version of the Type-7 userdefined logical record. It is designed for developmental purposes and for the exchange of miscellaneous images. This tagged-field logical record shall contain and be used to exchange, image data together with textual information fields pertinent to the digitized image. Such an image is usually not elsewhere specified or described in this Standard.

A fixed scanning resolution is not specified for this record type. However where resolution is a factor in the captured image, it shall be at least as great as the minimum scanning resolution, that is, 19.69 ppmm (500ppi). Increases in the resolution used for capturing images should follow the recommended migration path to 39.37 ppmm (1000 ppi), 78.74 ppmm (2000 ppi), etc. It should be noted that as the resolution is increased, more detailed ridge and structure information becomes available in the image.

The variable-resolution image data contained in the Type-16 logical record may be in a compressed form. With the exception of the tagged fields at the start of the record and the descriptors for the image data, the remaining details of the Type-16 record are undefined by this standard and shall be agreed upon between the sender and recipient.

5.1.15 Type-17 Iris image record

Type-17 tagged-field image records shall contain and be used to exchange iris image data. This record type was developed to provide a basic level of interoperability and harmonization with the ANSI INCITS 379-2004 Iris Image Interchange Format and the ISO/IEC 19794-6 iris image data interchange format. Generic iris images may be exchanged using the mandatory fields of this record type. Optional fields may also be used to exchange additional information. Although the iris standards provide for two alternative iris image interchange formats, the Type-17 record shall only address and establish provision for the rectilinear image storage format that may be a raw uncompressed array of intensity values or a compressed format of the raw data.

Records of this type will not be used by Interpol.

5.1.16 Type-99 CBEFF biometric data record

Type-99 logical records shall contain and be used to exchange biometric data that is not supported by other ANSI/NIST-ITL logical record types. This provides a basic level of interoperability and harmonization with the ANSI INCITS and other biometric interchange formats.

This is accomplished by using a basic record structure that is conformant with ANSI INCITS 398-2005, the Common Biometric Exchange Formats Framework (CBEFF) and a biometric data block specification registered with the International Biometrics Industry Association (IBIA). This logical record type supports and is intended to be used for biometric data types or formats that are not already represented by an existing ANSI/NIST data type.

A CBEFF conformant Biometric Information Record (BIR) is made up of a Header, a Biometric Data Block (BDB), and an optional Signature Block. The Type-99 logical record does not use the Signature Block. Information required by the Header portion is encoded as tagged fields within the Type-99 record. The final tagged field of the Type-99 record will contain biometric data as specified by the BDB interchange format.

Records of this type will not be used by Interpol.

5.2 Record format

A transaction file shall consist of one or more logical records. For each logical record contained in the file, several information fields appropriate to that record type shall be present. Each information field may contain one or more basic single-valued information items. Taken together these items are used to convey different aspects of the data contained in that field. An information field may also consist of one or more information items grouped together and repeated multiple times within a field. Such a group of information items is known as a subfield. An information field may therefore consist of one or more subfields of information items.

Record type	Data type	Preferred Pixel Density		Maximum Pixel Density	
		ppmm	ppi	ppmm	ppi
Type-3	Grayscale	9.84	250.00	10.34	252.50
Type-4	Grayscale	19.69	500.00	20.67	525.00

Type-5	Binary	9.84	250.00	10.34	252.50
Type-6	Binary	16.69	500.00	20.67	525.00

Table 6 Resolution of Transmitted fingerprint image recordes

5.2.1 Information separators

In the tagged-field logical records (Type-1, Type-2, and Type-9 through Type-15), mechanisms for delimiting information are implemented by use of the four ASCII information separators. The de-limited information may be items within a field or subfield, fields within a logical record, or multiple occurrences of subfields. These information separators are defined in the standard ANSI X3.4. These characters are used to separate and qualify information in a logical sense. Viewed in a hierarchical relationship, the File Separator “FS” character is the most inclusive followed by the Group Separator “GS”, the Record Separator “RS”, and finally the Unit Separator “US” characters. Table 6 lists these ASCII separators and a description of their use within this standard.

Information separators should be functionally viewed as an indication of the type data that follows. The “US” character shall separate individual information items within a field or subfield. This is a signal that the next information item is a piece of data for that field or subfield. Multiple subfields within a field separated by the “RS” character signals the start of the next group of repeated information item(s). The “GS” separator character used between information fields signals the beginning of a new field preceding the field identifying number that shall appear. Similarly, the beginning of a new logical record shall be signaled by the appearance of the “FS” character.

These separators shall be in addition to any other symbols, punctuation, or delimiters as specified in this standard.

The four characters are only meaningful when used as separators of data items in the fields of the ASCII text records. There is no specific meaning attached to these characters occurring in binary image records and binary fields – they are just part of the exchanged data.

Normally, there should be no empty fields or information items and therefore only one separator character should appear between any two data items. The exception to this rule occurs for those instances where the data in fields or information items in a transaction are unavailable, missing, or optional, and the processing of the transaction is not dependent upon the presence of that particular data. In those instances, multiple and adjacent separator characters shall appear together rather than requiring the insertion of dummy data between separator characters.

Consider the definition of a field that consists of three information items. If the information for the second information item is missing, then two adjacent “US” information separator characters would occur between the first and third information items. If the second and third information items were both missing, then three separator characters should be used – two “US” characters in addition to the terminating field or subfield separator character. In general, if one or more mandatory or optional information items are unavailable for a field or subfield, then the appropriate number of separator character should be inserted.

It is possible to have side-by-side combinations of two or more of the four available separator characters. When data are missing or unavailable for information items, subfields, or fields, there

must be one fewer separator characters present than the number of data items, subfields, or fields required.

Code	Type	Description	Hexadecimal Value	Decimal Value
US	Unit Separator	Separates information items	1F	31
RS	Record Separator	Separates subfields	1E	30
GS	Group Separator	Separates fields	1D	29
FS	File Separator	Separates logical records	1C	28

Table 7 Information separators

5.2.2 Record layout

For tagged-field logical records (Type-1, Type-2, Type-9, Type-10 through Type-17 and Type-99), each information field that is used shall be numbered in accordance with this standard. The format for each field shall consist of the logical record type number followed by a period ".", a field number followed by a colon ":", followed by the information appropriate to that field. The tagged-field number can be any one-to nine-digit number occurring between the period "." and the colon ":". It shall be interpreted as an unsigned integer field number. This implies that a field number of "2.123:" is equivalent to and shall be interpreted in the same manner as a field number of "2.000000123:".

NOTE: For purposes of illustration throughout this document, a three-digit number shall be used for enumerating the fields contained in each of the tagged-field logical records described herein. Field numbers will have the form of "TT.xxx:" where the "TT" represents the one- or two-character record type followed by a period. The next three characters comprise the appropriate field number followed by a colon. Descriptive ASCII information or the image data follows the colon.

Logical Type-1, Type-2, and Type-9 records contain only ASCII textual data fields. The entire length of the record (including field numbers, colons, and separator characters) shall be recorded as the first ASCII field within each of these record types. The ASCII File Separator "FS" control character (signifying the end of the logical record or transaction) shall follow the last byte of ASCII information and shall be included in the length of the record.

In contrast to the tagged-field concept, the Type-3 through Type-8 records contain only binary data recorded as ordered fixed-length binary fields. The entire length of the record shall be recorded in the first four-byte binary field of each record. For these binary records, neither the record number with its period, nor the field identifier number and its following colon, shall be recorded. Furthermore, as all the field lengths of these six records are either fixed or specified, none of the four separator characters ("US", "RS", "GS" or "FS") shall be interpreted as anything other than binary data. For these binary records, the "FS" character shall not be used as a record separator or transaction terminating character.

The Type-10 through Type-17 and Type-99 tagged-field image records combine ASCII fields with a single binary image field. Each ASCII field contains a numeric field identifier and its descriptive data. The last physical field in a tagged-field image record shall always be numbered 999 and shall contain the image data placed immediately following the colon (":") of the field identifier. The record length field shall contain the length of the record. The ASCII File

Separator “FS” control character shall follow the last byte of the compressed or uncompressed image data. The “FS” character shall signify the end of the logical record or transaction and shall be included as part of the record length.

5.2.3 International character sets

All of the fields in the Type-1 transaction record must be recorded using the 7-bit ASCII code, which is the default character set code within a transaction. In order to affect data and transaction interchanges between non-English speaking or based agencies, a technique is available to encode information using character sets other than 7-bit ASCII. Fields from the Type-1 logical record and ASCII “LEN” and “IDC” text fields must still be encoded using 7-bit ASCII. But all other designated text fields can be encoded using alternate character sets. The general mechanism for accomplishing this provides for backward compatibility with existing readers, supports multiple character sets in a single text string, and handles internationally accepted character sets and text order conventions such as ISO character sets, UTF-8, and Unicode.

To switch character sets within a transaction, the Type-1 record shall contain a field listing the Directory of Character Sets (DCS) used in the transaction. The DCS is an ordered list of triples, each consisting of 3 information items containing an identifying code, the name of an international character set, and its version. The code for a specific character set and other special codes shall be embedded in the transaction to signal the conversion to a different international character set. The ASCII Start-of-Text “STX” character (0x02) followed by the equal sign “=” is used to signal the change to an alternate character set defined by the specific DCS code that follows. The entire Start-of-Text sequence is terminated by a single instance of the ASCII End-of-Text “ETX” character (0x03). This alternate character set will remain active until a closing "ETX" character is encountered or the next ASCII information separator character is encountered.

The base-64 encoding scheme, found in email, shall be used for converting non-ASCII text into ASCII form. Annex C describes the use of the base-64 system. By convention, any language or character set text string following the Start-of-Text character sequence will be base-64 encoded for subsequent processing. The field number including the period and colon, for example “2.001:”, in addition to the *“US”*, *“RS”*, *“GS”*, and *“FS”* information separators shall appear in the transaction as 7-bit ASCII characters without conversion to base-64 encoding.

All text between the STX sequence and the closing ETX character shall be encoded in base-64 notation. This is true even when the 7-bit ASCII character set is specified.

Usage of UTF-8 is allowed as an alternative to the technique that requires the usage of the ASCII "STX" and "ETX" characters to signify the beginning or end of international characters. UTF-8 is only allowed to be used for user-defined fields of all the tagged-field records. Even though there is no overlap within the character sets used with UTF-8, it should be registered in the type 1 record within DCS field 1.15 (Directory of Character Sets).

6 Type-1 Logical Record: the File Header

6.1 Fields for Type-1 transaction information record

The following paragraphs describe the data contained in each field of the transaction information record. Each field shall begin with the number of the record type followed by a period followed by the appropriate field number followed by a colon. Table 8 provides a list of the fields for the transaction information record. Within a Type-1 logical record, entries shall be provided in numbered fields. It is required that the first two fields of the record are ordered. For each of the fields, Table 8 lists the “condition code” as being mandatory “M” or optional “O”, the field number, the field name, character type, field size, and occurrence limits. Based on a three digit field number, the maximum byte count size for the field is given in the last column. The two entries in the “field size per occurrence” include all character separators used in the field. The “maximum byte count” includes the field number, the information, and all the character separators. An entry containing an "*" indicate that there is no established limit. Annex F contains an example of the use of the standard that illustrates the layout for a Type-1 logical record

The character set used for Type-1 fields shall contain only the 7-bit ANSI code for information interchange.

Ident	Cond code	Field number	Field name	Char type	Field size per occurrence		Occur count		Max byte count
					min	max	min	max	
LEN	M	1.001	LOGICAL RECORD LENGTH	N	2	*	1	1	*
VER	M	1.002	VERSION NUMBER	N	5	5	1	1	11
CNT	M	1.003	FILE CONTENT	AN	4	6	2	*	*
TOT	M	1.004	TYPE OF TRANSACTION	A	4	5	1	1	11
DAT	M	1.005	DATE	N	9	9	1	1	15
PRY	O	1.006	PRIOTITY	N	2	2	0	1	8
DAI	M	1.007	DESTINATION AGENCY IDENTIFIER	N	*	*	1	1	*
ORI	M	1.008	ORIGINATING AGENCY IDENTIFIER	N	*	*	1	1	*
TCN	M	1.009	TRANSACTION CONTROL NUMBER	N	*	*	1	1	*
TCR	O	1.010	TRANSACTION CONTROL REFERENCE NUMBER	N	*	*	0	1	*
NSR	M	1.011	NATIVE SCANNING RESOLUTION	AN	6	7	1	1	13
NTR	M	1.012	NOMINLA SCANNING RESOLUTION	AN	6	7	1	1	13
DOM	O	1.013	DOMAIN NAME	AN	*	*	0	1	*
GMT	O	1.014	GREENWICH MEAN TIME	N	16	16	0	1	22
DCS	O	1.015	DIRECTORY OF CHARACTER SETS	AN	*	*	0	*	*

Table 8 Transaction informtion record layout

6.1.1 Field 1.001: Logical Record Length (LEN)

This mandatory ASCII field shall contain the total count of the number of bytes in this Type-1 logical record. Field 1.001 shall begin with "1.001:" followed by the length of the record including every character of every field contained in the record and the information separators. The *"GS"* separator character shall separate the length code of Field 1.001 from the next field.

NOTE: Although it will not always be explicitly repeated in the remainder of this standard, use of separators within the Type-1, Type-2, and tagged-field logical records shall always be observed. The *"US"* separator shall separate multiple information items within a field or subfield, the *"RS"* separator shall separate multiple subfields, and the *"GS*" separator shall separate information fields.

6.1.2 Field 1.002: Version Number (VER)

This mandatory four-byte ASCII field shall be used to specify the current version number of the standard implemented by the software or system creating the file. The format of this field shall consist of four numeric characters. The first two characters shall specify the major version number. The last two characters shall be used to specify the minor revision number. The initial revision number for a version shall be "00". The entry in this field for the 2000 version is "0300" and the entry for this 2007 version of the approved standard shall be "0400". This version number addresses the optional inclusion of the tagged-field logical Type-10 through Type-17 and Type-99 image records.

6.1.3 Field 1.003: File Content (CNT)

This mandatory field lists each of the records in the file by record type and the order in which the records appear in the logical file. It consists of one or more subfields, each of which in turn contains two information items describing a single logical record found in the current file. The subfields are entered in the same order in which the records are recorded and transmitted.

The first information item in the first subfield is "1", to refer to this Type-1 record. It is followed by a second information item which contains the number of other records contained in the file. This number is also equal to the count of the remaining subfields of field 1.003.

Each of the remaining subfields is associated with one record within the file, and the sequence of subfields corresponds to the sequence of records. Each subfield contains two items of information. The first is to identify the Type of the record. The second is the record's IDC which is generally in the range 0-16 (one Type-1, one or two Type-2, and 14 Type-4), but could be much higher if additional records are included. The "*US*" character shall be used to separate the two information items.

6.1.4 Field 1.004: Type of Transaction (TOT)

This mandatory field contains a three letter mnemonic designating the type of the transaction. These codes are different from those used by other implementations of the standard.

IRQ: Image Request. This transaction allows the fingerprint officer to retrieve fingerprints, palmprints and scenes of crime latents from an image database. It contains only sufficient information to enable the system to make a unique identification of the required prints or latents. For latents the Case Number (CNO), Sequence Number (SQN) and Latent Identifier (MID) must be specified, while for prints one of the following must be specified: Criminal Reference Number (CRO), Other Reference Number (ORN) or Miscellaneous Reference Number (MN1 to MN5).

IMR: Image Response. This transaction is for the transmission of a print or latent image from a collection, often in response to an IRQ transaction. The Type-2 record may contain textual information relevant to the image.

CPS: Criminal Print-to-Print Search. This transaction is a request for a search of a record relating to a criminal offence against a Prints database. If the person's prints are not already in the remote system they must be included as images in the file.

NPS: Non-Criminal Print-to-Print Search. This transaction is a request for a search against a Prints database that falls outside the scope of a CPS transaction. If the person's prints are not already in the remote system they must be included as images in the file.

MPS: Latent-to-Print Search. This transaction is used when a latent is to be searched against a Prints database. If the latent is not already in the remote system, it must be included as an image in the file.

PMS: Print-to-Latent Search. This transaction is used when a set of prints is to be searched against an Unidentified Latent database. If the person's prints are not already in the remote system they must be included as images in the file. If they are already present in the remote system, they may instead be specified by one of the unique identification numbers in the Type-2 record.

MMS: Latent-to-Latent Search. In this transaction the file contains a latent which is to be searched against an Unidentified Latent database in order to establish links between various scenes of crime. If the latent is not already in the remote system, it must be included as an image in the file.

DBS: Database Search. This transaction is intended primarily as a means of searching a remote image database, and only contains a Type-1 and a Type-2 record. The Type-2 record specifies the textual parameters for a fingerprint, latent or photo search. The result of the search is an SRE transaction which lists those fingerprints, latents or photos that meet the search criteria. The images can then be retrieved using an IRQ or an PHR request.

SRE: Search Results. This transaction contains a Type-1 and Type-2 record which detail the results of the search. The way fields are interpreted will depend on the original search request and to whom the search request was sent. If the SRE transaction is coming from an AFR system, the AFR system will specify a list of potential matches in the Respondents List (RLS). Additional information regarding the search, such as images and signatures can be attached to the record using Type-4, Type-7, Type-8 or Type-10 records.

USA: Add Latent to Unidentified Latents Collection. Besides containing the image of the latent being added to the database, or the image of a complete lift or photograph, the file includes a Type-2 record in which information is transmitted about the latent.

In some circumstances, a full lift or photograph of a sequence of latents is to be transmitted from one system to another, by agreement with both parties and not in response to an IRQ. In such circumstances the following apply:

- ∉ Any block on USA transactions must be removed.
- ∉ The image of the original must be transmitted as a Type-7 Record, captured at high resolution.

USR: Remove Latent from Unidentified Latents Collection. This transaction contains, besides the Type-1 record, only a Type-2 record in which enough information is given to uniquely specify the latent.

ATP: Add To Print Collection. This transaction is used for sending a complete set of prints (fingerprints and/or palmprints) or an entire fingerprint form to a remote site, as a new record or to replace an existing record. The FIB field (Fingerprint Identification Byte) of the Type-2 record identifies the reason for fingerprinting. The other fields in the record can be used to specify other details about the fingerprinted subject which may be stored by the AFR system or the image database.

In certain circumstances complete ten-print forms are to be transmitted from one system to another, by agreement with both parties and not in response to an IRQ. In such circumstances the following apply:

- ∉ Any block on ATP transactions must be removed.
- ∉ A Type-7 Record must be transmitted which contains an image of the full ten-print form. Field 7.04 (IMD) must be “47”.

SUP: Substitute Print(s) Into Existing Print-Collection. During this transaction individual print(s) are transmitted to replace those in an existing ten-print and/or palm-print.

DFP: Delete From Print Collection. This transaction is used to remove a complete record from a Print collection. Like the USR, this transaction only contains a Type-1 and a Type-2 record with enough information to uniquely identify the relevant record.

DIP: Disregard Individual Print(s) Update. This transaction advises the receiving agency that print(s) supplied by a previous SUP transaction should no longer be used.

CPR: Criminal Subject Photo Request. This transaction allows the police officer to retrieve a photo set from an image database. Each set of photos contains one or more photos of a subject posed from different views and other photos linked to the person (e.g. tattoos, scars). The Type-2 Record of this transaction contains only sufficient information to enable the system to make a unique identification of the person. One of the following should be specified: Criminal Reference Number (CRO), Other Reference Number (ORN) or Miscellaneous Reference Number (MN1 to MN5).

PHR: Photo Response. This transaction is for the transmission of a photo set from a collection, often in response to a CPR transaction. The Type-2 record may contain textual information relevant to the photo.

APC: Add To Print Collection. This transaction is used for sending a complete set of photos and if required a complete set of fingerprints to a remote site, as a new record or to replace an existing record. The FIB field (Fingerprint Identification Byte) of the Type-2 record identifies the reason for taking fingerprints and/or photos. The other fields in the record can be used to specify other details about the person which may be stored in the database.

DPC: Delete From Photo Collection. This transaction is used to remove a complete set of photos from a photo collection. Like the USR and DFP, this transaction only contains a Type-1 and a Type-2 record with enough information to uniquely identify the relevant record.

CPP: Criminal Photo-to-Photo Search. This transaction is a request for an automated search of a photo set relating to a criminal offence against a Photo database.

NPP: Non-Criminal Photo-to-Photo Search. This transaction is a request for an automated search against a Photo database that falls outside the scope of a CPP transaction.

UPR: Update Request. This transaction is used to update the alphanumerical and/or image data of one database record. This transaction must contain a Type-1 and a Type-2 record with enough information to uniquely identify the relevant record. The identification should be based on the information transmitted within CNO, MID, CRN, ORN and/or MN1-MN5 fields.

ERR: Error Message. This transaction is generated if the remote system has difficulty performing the transaction, e.g. if the unique reference number specified for an IRQ does not exist, or if a particular search is not allowed on the system. The Type-2 record will contain the error message. Which error messages are generated in what circumstances is an issue for the system designer.

The definition of these transactions implies that what appears to the officer performing a search as one transaction may, in fact, involve a number of separate transactions between the officer's workstation and the remote site.

It is likely that a system would be designed to block transactions initiated by a remote agency unless it had been specifically authorized by a senior user of the receiving agency.

One limitation of the standard is that it is not permissible for the file to have more than one transaction field. Thus if, say, a latent is to be searched against both the latents database and the prints database, two separate files must be sent.

Table 8 lists which records are permissible in the various transactions.

Transaction Type	Logical Record Type									
	1	2	4	7	8	9	10	13	14	15
IRQ	M	M	-	-	-	-	-	-	-	-
IMR	M	M	O*	O*	O	-	-	O*	O^3	O*
CPS	M	M	O	O	O	-	-	-	O^3	-
NPS	M	M	O	O	O	-	-	O	O^3	-
MPS	M	M	O^1	O^1	-	O	-	O^1	-	-
PMS	M	M	O	O	O	-	-	-	O^3	O
MMS	M	M	O^1	O^1	-	O	-	O^1	-	-
DBS	M	M	-	-	-	-	-	-	-	-
SRE	M	M	O	O	O	-	O	O	O^3	O
USA	M	M	O^2	O^2	-	-	-	O^2	-	-
USR	M	M	-	-	-	-	-	-	-	-
ATP	M	M	O*	O	O	-	-	-	O^3	O*
SUP	M	M	O*	-	-	-	-	-	O^3	O*
DFP	M	M	-	-	-	-	-	-	-	-
DIP	M	M	-	-	-	-	-	-	-	-
CPR	M	M	-	-	-	-	-	-	-	-
PHR	M	M	-	-	-	-	M	-	-	-
APC	M	M	O	O	O	-	M	-	O^3	O
DPC	M	M	-	-	-	-	-	-	-	-
CPP	M	M	-	-	-	-	M	-	-	-
UPR	M	M	O^1	O^1	O	O	O	O^1	O^3	O
NPP	M	M	-	-	-	-	M	-	-	-
ERR	M	M	-	-	-	-	-	-	-	-

Table 9 Permissible Codes in Transaction

Key: M = Mandatory
O = Optional
O* = At least one of these Logical Record Types must be included in this transaction type.
O^1 = The usage of Type-4 or Type-7 for the exchange of latent images is obsolete. If the remote system is compliant to this version of INT-I Type-13 records shall be used for latent transmissions.
O^2 = At least one of these Logical Record Types must be included in this transaction type. The usage of Type-4 or Type-7 for the exchange of latent images is obsolete. If the remote system is compliant to this version of INT-I Type-13 records shall be used for latent transmissions.
O^3 = If fingerprint images are send within Type-14 records it is mandatory to send these images within Type-4 records, too.
- = Not allowed

6.1.5 Field 1.005: Date of Transaction (DAT)

This mandatory field shall contain the date that the transaction was initiated. The date shall appear as eight digits in the format YYYYMMDD. The YYYY characters shall represent the year of the transaction; the MM characters shall be the tens and units values of the month; and the DD characters shall be the day in the month. For example, “20070103” represents January 3, 2007.

6.1.6 Field 1.006: Priority (PRY)

This optional field defines the priority, on a level of 1 to 9, with which the request is to be treated. "1" is the highest priority and "9" (the default if no priority field is present) the lowest. It is up to the receiving agency to define its policy on how each priority level is interpreted.

6.1.7 Field 1.007: Destination Agency Identifier (DAI)

This mandatory field specifies the destination agency for the transaction.

It consists of two information items in the following format:

CC/*agency*

The first information item contains the Interpol Country Code, defined in ISO 3166, two alpha-numeric characters long. The second item, *agency*, is a free text identification of the agency, up to a maximum of 32 alpha-numeric characters.

Destination Agency Identifier "ZZ/ALL" is reserved for transactions which shall be distributed by Interpol AFIS to all Interpol member states.

6.1.8 Field 1.008: Originating Agency Identifier (ORI)

This mandatory field specifies the file originator and has the same format as the DAI (Field 1.007).

6.1.9 Field 1.009: Transaction Control Number (TCN)

This mandatory field is a control number for reference purposes. It should be generated by the computer and have the following format:

YYSSSSSSSSA

where YY is the year of the transaction, SSSSSSSS is an eight-digit serial number, and A is a check character generated by following the procedure given in Appendix 2. The originating agency has to ensure that the TCN is unique and that no other transaction of the agency will have the same TCN.

Where a TCN is not available, the field, YYSSSSSSSS, is filled with zeros and the check character generated as above.

6.1.10 Field 1.010: Transaction Control Response (TCR)

Where a request was sent out, to which this is the response, this optional field will contain the transaction control number of the request message. It therefore has the same format as TCN (Field 1.009).

Where a TCR is not available, the field, YYSSSSSSSS, is filled with zeros and the check character generated as in TCN (Field 1.009).

6.1.11 Field 1.011: Native Scanning Resolution (NSR)

This mandatory field specifies the normal scanning resolution of the system supported by the originator of the transaction. It allows the recipient of a search request to send the response(s) at either the minimum (or default) scanning rate of 19.68 pixels/mm (500 pixels/inch) or, if it has the ability, at the scanning rate of the system which made the request. The resolution is specified as two numeric digits followed by the decimal point and then two more digits (e.g. "20.00").

If both recipient and sender use the same native sampling resolution it may be more efficient and less error prone if both systems exchange images at their native sampling resolution rather than using the default rate specified in the standard.

The current ANSI/NIST standard allows any sampling rate from 500 to 520 pixels/inch, but the intention is for new systems to adopt 500 pixels/inch or 19.68 pixels/mm.

For applications other than fingerprint where resolution is not a factor or not applicable (such a facial or SMT image) this field shall be set to "00.00".

6.1.12 Field 1.012: Nominal Transmitting Resolution (NTR)

This mandatory five-byte field specifies the nominal transmitting resolution for the images being transmitted. The resolution is expressed in pixels/mm in the same format as NSR (Field 1.011)

For applications other than fingerprint where resolution is not a factor or not applicable (such a facial or SMT image) this field shall be set to "00.00".

6.1.13 Field 1.013: Domain name (DOM)

This mandatory field identifies the domain name for the user-defined Type-2 logical record implementation. If present, the domain name may only appear once within a transaction. It shall consist of one or two information items. The first information item will uniquely identify the agency, entity, or implementation used for formatting the tagged fields in the Type-2 record. An optional second information item will contain the unique version of the particular implementation. For this version of the Interpol-Implementation the value of the field shall be “INT-I{US}5.00{GS}”.

6.1.14 Field 1.014: Greenwich mean time (GMT)

This mandatory field provides a mechanism for expressing the date and time in terms of universal Greenwich Mean Time (GMT) units. The GMT field contains the universal date that will be in addition to the local date contained in Field 1.005 (DAT). Use of the GMT field eliminates local time inconsistencies encountered when a transaction and its response are transmitted between two places separated by several time zones. The GMT provides a universal date and 24-hour clock time independent of time zones. It is represented as "CCYYMMDDHHMMSSZ", a 15-character string that is the concatenation of the date with the GMT and concludes with a "Z". The "CCYY" characters shall represent the year of the transaction, the "MM" characters shall be the tens and units values of the month, and the "DD" characters shall be the tens and units values of the day of the month, the "HH" characters represent the hour, the "MM" the minute, and the "SS" represents the second. The complete date shall not exceed the current date.

6.1.15 Field 1.015: Directory of character sets (DCS)

This optional field is a directory or list of character sets other than 7-bit ASCII that may appear within this transaction. This field shall contain one or more subfields, each with three information items. The first information item is the three-character identifier for the character set index number that references an associated character set throughout the transaction file. The second information item shall be the common name for the character set associated with that index number, the optional third information item is the specific version of the character set used. Table 9 lists the reserved named character sets and their associated 3-character index numbers. The "US" character shall separate the first information item from the second and the second from the third. The "RS" separator character shall be used between the subfields.

Character set index	Character set name	Description
000	ASCII	7-bit English (Default)
001	ASCII	8-bit Latin
002	UNICODE	16-bit
003	UTF-8	8-bit
003-127		Reserved for ANSI/NIST future use
128-999		User-defined character sets

Table 10 Directory of character sets

6.1.16 End of transaction information record Type-1

Immediately following the last information field in the Type-1 logical record, an *"FS"* separator character shall be used to separate it from the next logical record. This *"FS"* character shall replace the *"GS"* character that is normally used between information fields.

7 Type-2 Logical Record: Descriptive Text

The structure of most of this record is not defined by the ANSI/NIST standard. The record contains information of specific interest to the agencies sending or receiving the file. To ensure that communicating fingerprint systems are compatible the INT-I requires that only the fields listed below are contained within the record. This document specifies which fields are mandatory and which optional, and also defines the structure of the individual fields.

Currently the numbers 001 to 085 have been assigned to specific fields. Numbers 086 to 199 are reserved for future additions to the INT-I. The fields above 2.200 are outside the scope of the INT-I and may be used for national requirements or by system implementers for information specific to their systems.

A file may contain only a small subset of these fields, depending on the transaction taking place.

The character set used for the first Type-2 record shall contain only the 7-bit ANSI code for information interchange. If the transaction contains a second Type-2 record this one may be used for information exchange with other character sets defined within Field 1.015.

7.1 Fields for Type-2 Logical Record

Fields 2.001 to 2.003 are mandatory in all records. They give essential information about the record.

7.1.1 Field 2.001: Logical Record Length (LEN)

This mandatory field contains the length of this Type-2 record, and specifies the total number of bytes including every character of every field contained in the record and the information separators.

7.1.2 Field 2.002: Image Designation Character (IDC)

The IDC contained in this mandatory field is an ASCII representation of the IDC as defined in the file content field of the Type-1 record.

7.1.3 Field 2.003: System Information (SYS)

This field is mandatory and contains four bytes which indicate which version of the INT-I this particular Type-2 record complies with. This feature gives the INT-I the ability to evolve as necessary while still allowing a system to process transactions generated by a system complying with an older version of the INT-I.

The first two bytes specify the major version number, the second two the minor revision number. For example, this implementation is version 4 revision 22 and would be represented as “0422”.

Fields 2.004 and 2.005 contain general information regarding the file. Their use is optional in most transactions.

7.1.4 Field 2.004: Date of Record (DAR)

This specifies the date, in ISO format, on which the record was first created, and is formatted according to the ISO standard

YYYYMMDD

where YYYY is the year, MM is the month, and DD is the day, as explained in DAT (Field 1.005). This field will probably be generated automatically.

7.1.5 Field 2.005: Date of Last Update (DLU)

This specifies the most recent date on which the data was changed in the record. The field is formatted in the ISO standard of

YYYYMMDD

where YYYY is the year, MM is the month, and DD is the day, as explained in DAT (Field 1.005). Like Date of Record (see above) this field would be generated by the system when the fingerprint record is amended.

Fields 2.006 to 2.016 are reference information which give information about the nature of the file and its contents. They are, in general, optional, although some are mandatory for certain transactions.

7.1.6 Field 2.006: Send Copy To (SCT)

This field indicates to the receiver to send the response of the transaction to other stations. It consists of one or more subfields, each having the format of DAI (Field 1.007), namely up to two alpha-numeric characters for the Interpol Country Code and up to 32 alpha-numeric characters of free text.

7.1.7 Field 2.007: Case Number (CNO)

This is a number assigned by the local fingerprint bureau to a collection of latents found at a scene-of-crime. The following format is adopted:

CC/*number*

where CC is the Interpol Country Code, two alpha-numeric characters in length, and the *number* complies with the appropriate local guidelines and may be up to 32 alpha-numeric characters long.

This field allows the system to identify latents associated with a particular crime.

7.1.8 Field 2.008: Sequence Number (SQN)

This specifies each sequence of latents within a case. It can be up to four numeric characters long.

A sequence is a latent or series of latents which are grouped together for the purposes of filing and/or searching. This definition implies that even single latents will still have to be assigned a sequence number.

In the case of search requests the field is included for identification purposes: if the remote system is an AFR system it can use the case number, sequence number and latent identifier to determine whether it already has an AFR encoding of the latent.

This field together with MID (Field 2.009) may be included to identify a particular latent within a sequence.

7.1.9 Field 2.009: Latent Identifier (MID)

This specifies the individual latent within a sequence. The value is a single letter, with 'A' assigned to the first latent, 'B' to the second, and so on up to a limit of 'J'.

This field is used analog to the latent sequence number discussed in the description for SQN (Field 2.008).

7.1.10 Field 2.010: Criminal Reference Number (CRN)

This is a unique reference number assigned by a national agency to an individual who is charged for the first time with committing an offence. Within one country no individual ever has more than one CRN, or shares it with any other individual. However, the same individual may have Criminal Reference Numbers in several countries, which will be distinguishable by means of the country code.

The CRN field consists of at least one subfield, which in turn consists of two information items. The following format is adopted for each subfield:

CC/*number*

where CC is the Interpol Country Code, two alpha-numeric characters in length, and the *number* complies with the appropriate national guidelines of the issuing agency, and may be up to 32 alpha-numeric characters long.

In the case of CPS transactions, the fingerprint officer may believe that he/she already knows the CRN (e.g. as the result of a name check). This field will then specify that CRN, and will allow a verification to be carried out before a print-to-print search on the complete database is initiated.

In the case of PMS searches this field may be used to specify the CRN of the person whose ten-prints are to be searched against an Unidentified Latents collection. This may be useful if the remote system has already encoded and filed the individual's prints.

In an SRE transaction in which the identity of the subject is certain, the CRN is of that individual. For example, Agency A might initiate an SRE transaction, in response to a CPS from Agency B, after an Agency A fingerprint expert has examined the fingerprints and identified the individual. System design should ensure that the response makes clear what has been done.

Similarly, for an IRQ the field may be used to find a given individual's prints in the collection. In this case the responding IMR may contain the same CRN.

7.1.11 Field 2.011: Other Reference Number (ORN)

This is a unique reference number for a ten-print set which does not have a CRN. It is very similar in format and function to CRN (Field 2.010). The field consists of at least one subfield, which in turn consists of two information items. The following format is adopted for each subfield:

CC/*type_number*/*ref_number*

where CC is the Interpol Country Code, two alpha-numeric characters in length, *type_number* consists of up to 32 alpha-numeric characters of free text defining the type of reference number, and *ref_number* complies with the appropriate national guidelines of the issuing agency, and may be up to 32 alpha-numeric characters long.

7.1.12 Field 2.012: Miscellaneous Identification Number (MN1)

Any miscellaneous identification numbers may be entered in this and the following four fields (MN1 to MN5). Each of these fields may have a maximum length of 32 alpha-numeric characters.

7.1.13 Field 2.013: Miscellaneous Identification Number (MN2)

This field shall be the CONTROL No. from the Interpol notices.

7.1.14 Field 2.014: Miscellaneous Identification Number (MN3)

This field shall be the FILE No. from the Interpol notices.

7.1.15 Field 2.015: Miscellaneous Identification Number (MN4)

7.1.16 Field 2.016: Miscellaneous Identification Number (MN5)

Fields 2.017 to 2.025 are used to give information about specific images involved in the transaction. For this reason, if the fingerprints were not taken at the same session each must have as many subfields as there are images in the file. These subfields form a list of data, each consecutive element relating to the respective image in the file. The requirement for these fields depends upon the transaction being undertaken.

7.1.17 Field 2.017: Finger Number (FNU)

This field consists of a number of subfields.

The first subfield consists of one of the letters T, F or I, which have the following meaning:

T All ten rolled fingerprints were obtained at the same session (the usual circumstance), and the descriptive fields are associated with all ten images.

F All 14 fingerprints, including both rolled and plain, were obtained at the same session, and the descriptive fields are associated with all 14 images.

I The separate prints are specified individually. Each subfield after the first contains a finger number from FGP (Field 4.04) or an image description from IMD (Field 7.04).

If the first subfield is I then any of Fields 2.018 to 2.025 inclusive which are used will contain a number of subfields, each relating to the respective image in this FNU field.

7.1.18 Field 2.018: Fingerprint Identification Byte (FIB)

This field consists of one subfield for each corresponding subfield in FNU (Field 2.017)

Each subfield contains two characters which are used to indicate the reason for fingerprinting. It has one of the following values:

00	Caution
01	Charge
02	Prison
03	Composite Indicator
04	Suspect not Charged
05	Immigration
06	Asylum
07	Elimination
08	Police Officer
09	Scene of Crime Officer
10	Other reason

In the case of "10", RFP (Field 2.021) can be used to give a more detailed description.

In search transactions the field specifies the nature of a transmitted set of ten-prints. In SRE and IMR responses the field will specify the nature of the ten-prints being examined and will therefore effectively echo the original search or image retrieval request.

7.1.19 Field 2.019: Date Fingerprinted (DPR)

This field consists of one subfield for each corresponding subfield in FNU (Field 2.017), and is intended to be used for both prints and latents.

For prints this field contains the date on which the subject was fingerprinted and refers to the date on which the prints included in the transaction were taken.

For latents this field specifies the date on which the latent was inspected at the scene of the crime by a scene examiner.

The format is the ISO standard of

YYYYMMDD

where YYYY is the year, MM is the month, and DD is the day, as explained in DAT (Field 1.005).

7.1.20 Field 2.020: Time of Fingerprinting (TOF)

This field consists of one subfield for each corresponding subfield in FNU (Field 2.017), and is intended for use with prints.

It specifies the time at which fingerprints were taken. The format is

HHMM

where HH is a two digit hour reference and MM a similar minute reference. Standard twenty-four hour clock notation will be used (e.g. "0730", "1752" etc). Midnight should be recorded as either "2359" or "0001", instead of "2400" or "0000".

7.1.21 Field 2.021: Reason Fingerprinted (RFP)

This field consists of one subfield for each corresponding subfield in FNU (Field 2.017).

It is an alpha-numeric field with a maximum length of 128 alpha-numeric characters and is to allow the human operator to enter an extra message, for example giving further details of the reason for fingerprinting or information about how a search is to be carried out.

7.1.22 Field 2.022: Place Of Arrest (POA)

This field consists of one subfield for each corresponding subfield in FNU (Field 2.017).

Each subfield specifies the place of arrest, or the place where the fingerprints were taken, in the same format as DAI (Field 1.007.

7.1.23 Field 2.023: Owning Bureau (OBU)

This field consists of one subfield for each corresponding subfield in FNU (Field 2.017), and is intended for use with both prints and latents. The format of the field is the same as that used in POA (Field 2.022) and DAI (Field 1.007).

7.1.24 Field 2.024: Date of Notice (DON)

This field consists of one subfield for each corresponding subfield in FNU (Field 2.017). It specifies the Date of Notice of the record.

The format is according to the ISO standard of

YYYYMMDD

where YYYY is the year, MM the month and DD the day, as explained in DAT (Field 1.005).

7.1.25 Field 2.025: Station Inputting Latent (SIM)

This field specifies the local office inputting the latent. Its format is the same as DAI (Field 1.007.

Fields 2.026 to 2.028 are used to specify information about image quality and the type of pattern classification used. The precise definition of these fields is to be determined and will be published in a future revision of the INI-I.

7.1.26 Field 2.026: Quality Measure (QLM)

This field contains at least one subfield. Each subfield contains two information items: the first is the IDC code of the finger or palm to which this subfield refers, and the second is a quality measure assigned either by the fingerprint examiner or automatically by the system.

The quality measure is defined as a numeric value beginning with 0 for the poorest quality and 100 for the best quality.

e.g. 2.026:4<US>60<RS>6<US>80<GS>

A quality measure below 50 shall force a manual verification if the destination system performs automated coding and/or classification.

7.1.27 Field 2.027: Coarse Classification of Patterns (CCP)

This field contains at least one subfield. Each subfield contains at least two information items: the first is the IDC code of the finger to which this image refers, and the second is the character

representing the coarse classification. Each subsequent information item specifies a further coarse classification of the fingerprint, which permits allowances. The coarse classification is represented by an alpha-numeric character, but the precise classification to be employed is yet to be determined.

7.1.28 Field 2.028: Fine Classification of Patterns (FCP)

This represents the detailed code for the fingerprint pattern class. It contains a number of subfields where each subfield contains at least three information items. The first information item is the IDC of the relevant image. The second is either S or F, recommending whether the pattern is for filing or searching. The third is a character string with between 1 and 4 alpha-numeric characters containing the fine classification. If the fine classification is doubtful, more than one fine classification may follow the IDC code.

The precise classification to be employed is yet to be determined.

Fields 2.029 to 2.051 are used in several transactions to convey personal information relating to the file. This information is generally used for filing purposes, although there are some cases where this personal information may be used for searches.

7.1.29 Field 2.029: Nominal File (NLF)

This field consists of two subfields. The first subfield is a single byte. The value of the first subfield is « 0 » if the data contained in fields 2.030 to 2.051 is transmitted within this Type 2 record. The value of the first subfield is « 1 » if the data is transmitted using a Formatted Message. If the first subfield is « 0 » then the second subfield is blank. If the first subfield is « 1 » then the second contains a reference to the Formatted Message in free text, up to 32 alpha-numeric characters.

7.1.30 Field 2.030: Name (NAM)

This field contains the names of the subject. The format is:

family_name/*name*/*name*/ . . .

For instance Charles Peter Bell would appear as "BELL/CHARLES/PETER". If only the family name (surname) is known then this is followed by a single slash. The entire field is limited to 64 characters including the slashes. Spaces, apostrophes, hyphens and full stops that occur within a component name should be entered as such. If the name is longer than 64 characters the 64th character should be a plus sign. The plus sign can only be used in the final position.

7.1.31 Field 2.031: Maiden Name (MNA)

The format of this field is identical to NAM (Field 2.030), and is limited to 64 characters including the slashes. Spaces, apostrophes, hyphens and full stops that occur within a component

name should be entered as such. If the name is longer than 64 characters the 64th character should be a plus sign. The plus sign can only be used in the final position.

7.1.32 Field 2.032: Address (ADD)

This field contains the address of the subject, in free text up to 128 alpha-numeric characters.

7.1.33 Field 2.033: True Identity (TRU)

This field contains information on how the individual's true identity was determined. It consists of two information items in the following format:

A/*description*

The first information item contains a single binary digit, A, which is "0" (the default value) if true identity has not been established, or "1" if a positive result to an investigation has been obtained. The *description* consists of 128 characters of free text, describing the manner in which the true identity was established.

7.1.34 Field 2.034: Aliases (AKA)

If present this field consists of at least one subfield. Each subfield is formatted as NAM (Field 2.030). Its use is identical to NAM.

7.1.35 Field 2.035: Date of Birth (DOB)

This field specifies the date of birth in ISO format:

YYYYMMDD

where YYYY is the year, MM is the month, and DD is the day, as explained in DAT (Field 1.005).

7.1.36 Field 2.036: Date of Birth Range (DBR)

Sometimes it will not be possible to specify the date of birth exactly. In such circumstances a date of birth range may specified. The Format of the field is

YYYYMMDDQYYYYMMDD

where the two strings YYYYMMDD are the two ISO dates defining the range, and Q is qualifier, whose value is always 4, separating the two dates. Thus if the range is between 1st December 1995 and 31st January 1996, the field value will be « 19951201419960131 ».

The dates may include the wildcard character *, which can be used both if the start or end of the period is uncertain (eg. « ********419940101 ») and if the dates cannot be specified exactly (eg. 1992****419930101 »).

7.1.37 Field 2.037: Place of Birth (POB)

This field consists of up to three information items and specifies the place of birth.

The format is

CC/*country*/*town*

where CC is the Interpol Country Code, two alpha-numeric characters long, *country* is the free text equivalent, up to 32 characters long, and *town* is the free text name of the town of birth, up to 32 characters long.

7.1.38 Field 2.038: Nationality (NAT)

This field consists of up to two information items and specifies the nationality of the fingerprinted subject.

The format is

CC/*nationality*

The first information item contains the Interpol Country Code, defined in ISO 3166, two alpha-numeric characters long, and *nationality* is the free text equivalent, up to 32 characters long.

7.1.39 Field 2.039: Sex (SEX)

This is a single letter code representing the sex of the subject:

female	F
male	M
not certain	U

7.1.40 Field 2.040: Color (COL)

This is a single letter code representing the color of the fingerprinted subject. It is a one letter code:

white	W
non-white	N
not certain	U

7.1.41 Field 2.041: Height (HGT)

This field specifies the subject's height. The first letter indicates whether the height is in feet and inches or in centimeters:

F	The units are imperial, i.e. feet and inches
M	The height is defined in centimeters.

The first letter is followed by a three-digit number (including leading zeros) representing the height. For an imperial measure the first digit indicates the feet whilst the second and third digits represent the inches which may range from 00-11. For instance, for a person 5ft 8in (173 cm) tall this field would be either "F508" or "M173".

7.1.42 Field 2.042: Build (BLD)

This field is up to 32 characters long, and contains a free-text description of the subject's build.

7.1.43 Field 2.043: Hair (HAI)

This field is up to 32 characters long, and contains a free-text description of the color and style of the subject's hair.

7.1.44 Field 2.044: Face (FAC)

This field is up to 256 characters long, and contains a free-text description of the subject's face.

7.1.45 Field 2.045: Languages Spoken (LAN)

This field consists of up to ten subfields, each of which consists of two information items, and specifies the languages spoken by the fingerprinted subject.

The format of each subfield is free text up to 32 characters long.

7.1.46 Field 2.046: Photograph Number (PHO)

This field consists of two subfields, the first subfield being a single character.

If no photograph of the subject is available then the subfield contains "0" and the second subfield is empty. If a photograph is available then the first subfield contains "1".

The second subfield is up to 32 alpha-numeric characters long, and contains the reference number of the photograph.

7.1.47 Field 2.047: Passport Number (PSP)

This field contains a passport number and is up to 32 alpha-numeric characters long.

7.1.48 Field 2.048: Marks etc (MAR)

This field consists of up to 16 subfields, each being 64 alpha-numeric characters of free text describing marks, scars and tattoos of the fingerprinted subject. If images of the marks, scars and/or tattoos exists they should be included as Type 10 records within the transaction.

7.1.49 Field 2.049: Occupation (OCC)

This field contains a free text description of the subject's occupation, and is up to 64 characters long.

7.1.50 Field 2.050: Warning (WNG)

This is a free text field, up to 32 alpha-numeric characters, warning if the subject is dangerous (e.g. carries firearms, violent, etc.)

7.1.51 Field 2.051: Modus Operandi (MDO)

This field contains a free text description of the subject's normal modus operandi, and is up to 64 characters long.

Fields 2.052 to 2.063 are search criteria. In most cases, it is possible to allow a range of values to be specified within a type of criterion as well as exact values. Special fields are included to allow this. In these cases, either, but not both, of the fields may be used to search on the basis of a particular aspect.

7.1.52 Field 2.052: Geographical Area of Crime (GAC)

This field indicates the geographical area in which the crime was committed. The field consists of one or more information items in the following format:

CC/*area*/*GIS*

The first item contains the Interpol Country Code, two alpha-numeric characters long. The second, *area*, is a free text identification of the area, up to a maximum of 256 alpha-numeric characters, and may include the actual address at which the offence was committed. The third (optional) item, up to 16 alpha-numeric characters long, can contain a reference number as generated by a Geographical Information System. The format of the number is unspecified.

7.1.53 Field 2.053: Geographical Search Area (GSA)

This field is split into one or more subfields, each specifying a geographical region as two information items in the following format:

CC/*area*

where CC is the Interpol Country Code, two alpha-numeric characters long, and the second information item, *area*, is a free text identification of the area, up to a maximum of 32 alpha-numeric characters.

If omitted in a latent search, then the system should ensure that the geographical search area defaults to the area specified in GAC (Field 2.052).

The field may also be present in search and image responses, when the field would be simply a copy of that appearing in the original request transaction.

7.1.54 Field 2.054: Offence Type (OTY)

This field identifies the type of crime committed. It consists of up to seven subfields, each of which is free text up to 64 alpha-numeric characters long.

7.1.55 Field 2.055: Date of Offence (DOO)

This field specifies the date in ISO format (YYYYMMDD) on which the offence was committed. In searches it may be used interchangeably with DOR (Field 2.056).

If present in a search it records the date on which the crime was committed.

7.1.56 Field 2.056: Date of Offence Range (DOR)

Sometimes it will not be possible to specify the date of the offence exactly. In such circumstances a date of offence range may be specified. The format of the field is

YYYYMMDDQYYYYMMDD

where the two strings YYYYMMDD are the two ISO dates defining the range, and Q is a qualifier, whose value is always "4", separating the two dates. Thus if the range is between 1st December 1995 and 31st January 1996, the field value will be "19951201419960131".

The dates may include the wildcard character *, which can be used both if the start or end of the period is uncertain (e.g. "********419940101") and if the dates cannot be specified exactly (e.g. "1992****419930101").

The use of the field is similar to that of DOO (Field 2.055).

7.1.57 Field 2.057: Date of Offence Search Range (DSR)

This field has the same format as DOR (Field 2.056), including the same wildcarding mechanism. It is analogous to GSA (Field 2.053) and can be used to specify a search range. Only prints or latents whose DOO or DOR (Fields 2.055 and 2.056 respectively) lie within the listed date range will be included in the search.

7.1.58 Field 2.058: Time of Offence (TOO)

This field specifies the time at which the offence was thought to be committed. The format is the same as TOF (Field 2.020).

7.1.59 Field 2.059: Time of Offence Range (TOR)

When it is not possible to specify the exact time of the crime, a range of time may be recorded, similarly to DOR (Field 2.056).

The format of this range is

HHMMQHHMM

where the strings HHMM are the two four-figure time references defining the range, as used in TOF (Field 2.020), and Q is a qualifier, whose value is always "4", separating the two times.

7.1.60 Field 2.060: Time of Offence Search Range (TSR)

This field has the same format as TOR (Field 2.059). It is analogous to GSA (Field 2.053) and can be used to specify a search range. Only prints or latents whose TOO or TOR (Fields 2.058 and 2.059 respectively) lie within the listed date range will be included in the search.

7.1.61 Field 2.061: Time Limit (TLM)

If there is a time limit within which a prosecution is to be processed then this field contains the latest date by which the results must be received. Its format is the ISO standard notation, as in DAT (Field 1.005).

7.1.62 Field 2.062: ICPO/GS (ICP)

This field consists of a single binary digit: "0" if the request has not been sent to the Interpol General Secretariat, or "1" if it has been sent.

7.1.63 Field 2.063: Additional Information (INF)

This field, consisting of 32 alpha-numeric characters, gives a contact point (e.g. name, phone number) for further information about the request.

Fields 2.064 to 2.066 contain information regarding the response to an inquiry, and their presence is highly dependent upon the type of transaction being undertaken. It should be noted that local legislation or guidelines may prohibit the transmission of images which have not been verified. Thus the procedure adopted may be for the local agency to provide resources to verify respondents before initiating a response to the remote agency, and to return only confirmed matches.

7.1.64 Field 2.064: Respondents List (RLS)

This field contains at least two subfields. The first subfield describes the type of search that has been carried out, using the three-letter mnemonics which specify the transaction type in TOT (Field 1.004).
The second subfield contains a single character. An "**I**" shall be used to indicate that a HIT has been found and an "**N**" shall be used to indicate that no matching cases have been found (NOHIT).
The third subfield contains the sequence identifier for the candidate result and the total number of candidates separated by a slash. Multiple messages will be returned if multiple candidates exist.
In case of a possible HIT the forth subfield shall contain the score up to six digits long. If the HIT has been verified the value of this subfield shall be "999999"

Example: "CPS{RS}I{RS}001/005{RS}10205{GS}"

In some implementations legal constraints or local guidelines will mandate that the field is restricted to the number of verified respondents only.

If the remote AFR system does not assign scores, then a score of zero should be used at the appropriate point.

7.1.65 Field 2.065: Recipient Countries (COU)

When a search is to be carried out against the databases of a number of countries, this field provides confirmation on which have actually been searched. It consists of a number of subfields, each of which consists of two information items. The first contains the two character Interpol Country Code of the country whose database was to be searched. The second is a single binary digit: "0" if the search was not carried out and "1" if the search was carried out.

7.1.66 Field 2.066: Result (RES)

This field contains up to 128 alpha-numeric characters of free text, giving the address to which the response to a transaction should be sent, if this is to be done other than electronically using an ANSI/NIST message.

Fields 2.067 to 2.071 are flags whose presence prompts an action to be taken regarding some part of the transaction. In all cases they are optional and their use may be limited to certain transactions.

7.1.67 Field 2.067: Alert Flag (ALF)

The alert flag is to indicate who should be informed if a match is made involving the latent or print. It contains three information items in the following format:

CC/*agency*/*additional_information*

CC is the Interpol Country Code, two alpha-numeric characters long. The second item, *agency*, is a free text identification of the agency, up to a maximum of 32 alpha-numeric characters. The third is a 128 alpha-numeric string in which extra information might be added, e.g. a contact person or a telephone number. This item is not intended to be interpreted by computer.

A possible use for this field is to indicate a terrorist or a violent criminal.

7.1.68 Field 2.068: Target Criminal Flag (TCF)

This indicates whether the subject is considered to be somebody likely to commit an offence and whose fingerprints should always be included in a search irrespective of the defined search scope. The field has one of two possible values:

0 The subject is not a target criminal
1 The subject is a target criminal

If the field is not present a default value of 0 is assumed. The main use of the field is in submitting images to an AFR system for a search or to an image database for filing.

7.1.69 Field 2.069: Identified Flag (IDF)

This field indicates that a given individual has left latents in various areas which have been successfully matched. The field consists of one or more subfields each of which refers to an identified case. The first three information items in a subfield define the geographical area in which the matching latent was found, in the same format as GAC (Field 2.049). The fourth information item, which is optional, is the case number of the identified latent.

7.1.70 Field 2.070: Latent Priority Flag (MPF)

This is the latent equivalent of a TCF (Field 2.068) flag. It indicates that the latent is connected with a particularly serious crime and that it should always be included in any searches of an Unidentified Latents database. The flag takes one of two values:

0 The latent is not a priority latent
1 The latent is a priority latent

7.1.71 Field 2.071: Tie Up Flag (TUF)

This field is used to indicate that the latent to which it refers has been connected with one or more other latents. Each subfield refers to one of these other latents and consists of up to four information items relating to it: GAC, CNO, SQN, and MID (Fields 2.049, 2.007, 2.008 and 2.009 respectively) or MN1 to MN5 (Fields 2.014 to 2.018). The flag shall be set, in both inquiry and respondent latents, after a successful latent-to latent search.

Fields 2.072 to 2.073 are included only if there is a Type-8 Logical Record, i.e. a signature image.

7.1.72 Field 2.072: Rank (RNK)

This field consists of up to 16 alpha-numeric characters, and contains a free text description of the rank or grade of the officer providing the signature.

7.1.73 Field 2.073: Date signature (DSG)

This field contains the date at which the signature was written, and will probably be supplied automatically by the system. It is in the same ISO format as DAR (Field 2.004).

Finally, field 2.074 is included to allow the passing of status and error messages. Its use is limited to Error Transactions (ERR), during which it is mandatory. It must not be present in any other transaction3d.

7.1.74 Field 2.074: Status/Error Message Field (ERM)

This field contains error messages resulting from transactions, which will be sent back to the requester as part of an Error Transaction.

Numeric Code (1-3)	Meaning (5-128)
001	ERROR: RECORD NOT FOUND
002	ERROR: RECORD ALREADY EXISTS

Numeric Code (1-3)	Meaning (5-128)
003	ERROR: UNAUTHORISED ACCESS
101	MANDATORY FIELD MISSING
102	INVALID RECORD TYPE
103	UNDEFINED FIELD
104	EXCEED THE MAXIMUM OCCURRENCE
105	INVALID NUMBER OF SUBFIELDS
106	FIELD LENGTH TOO SHORT
107	FIELD LENGTH TOO LONG
108	FIELD IS NOT A NUMBER AS EXPECTED
109	FIELD NUMBER VALUE TOO SMALL
110	FIELD NUMBER VALUE TOO BIG
111	INVALID CHARACTER
112	INVALID DATE
113	INVALID TIME
114	INVALID DATE OR TIME
115	INVALID ITEM VALUE
116	INVALID TYPE OF TRANSACTION
117	INVALID RECORD DATA
201	ERROR: INVALID TCN
501	ERROR: INSUFFICIENT FINGERPRINT QUALITY
502	ERROR: MISSING FINGERPRINTS
503	ERROR: FINGERPRINT SEQUENCE CHECK FAILED
999	ERROR: ANY OTHER ERROR. FOR FURTHER DETAILS CALL DESTINATION AGENCY.

Table 11 Error messages

Error messages in the range between 100 and 199:

These error messages are related to the validation of the ANSI/NIST records and defined as:

<error_code 1>: IDC <idc_number 1> FIELD <field_id 1> <dynamic text 1> LF
<error_code 2>: IDC <idc_number 2> FIELD <field_id 2> <dynamic text 2>…

where
- error_code is a code uniquely related to a specific reason (see table)
- field_id is the ANSI/NIST field number of the incorrect field (e.g. 1.01, 2.001, ...) in the format <record_type>.<field_id>.<sub_field_id>
- dynamic text is a more detailed dynamic description of the error
- LF is a Line Feed separating errors if more then one error is encountered

Example:
106: ICD 15 FIELD 1.09 SIZE 8 < MIN SIZE 11 {LF}
109: IDC 0 FIELD 2.001.0 VALUE 0 < MIN VALUE 2

This field is mandatory for error transactions.

7.1.75 Field 2.075: Father´s Family Name (FFN)

This field contains the names from the father of the subject.
The format is the same as NAM (Field 2.030).

7.1.76 Field 2.076: Mothers´s Maiden Name (MMN)

This field contains the names from the mother of the subject.
The format is the same as NAM (Field 2.030).

7.1.77 Field 2.080: Broadcast Request To (BRT)

This field shall indicate that the receiver of a request shall distribute it to multiple destination agencies. The field consists of several subfields containing the agency names as described in Field 1.007 (DAI).

7.1.78 Field 2.083: Finger Present (FPR)

This field shall give information about missing fingerprints. It may consist of one or more subfields containing the Finger Number (FGP, see table 11) two digits long and information about the finger:

Descriptor	Code
Amputation	XX
Unable to print (e.g., bandaged)	UP
No information about missing finger	NA

Table 12

Example: "01{US}XX{RS}08{US}UP{RS}10{US}NA{GS}"

7.1.79 Field 2.085: Additional Response Information (ARI)

This field, consisting of up to 2048 alpha-numeric characters of free text, shall be used to give further information about the result of a search back to the requester.
This field is mandatory if the descriptive or fingerprint data of a HIT may not be sent within a SRE transaction.

8 Type-4 Logical Record: High Resolution Gray-Scale Image

It should be noted that Type-4 records are binary rather than ASCII in nature. Therefore each field is assigned a specific position within the record, which implies that all fields are mandatory.

The standard allows both image size and resolution to be specified within the record. It requires Type-4 Logical Records to contain fingerprint image data that are being transmitted at a nominal pixel density of 500 to 520 pixels per inch. The preferred rate for new designs is at a pixel density of 500 pixels per inch or 19.68 pixels per mm. 500 pixels per inch is the density specified by the INT-I, except that similar systems may communicate with each other at a non-preferred rate, within the limits of 500 to 520 pixels per inch.

For a system to comply with the INT-I it is necessary (although not sufficient) that it can send and receive fingerprints as Type-4 records.

8.1 Fields for Type-4 Logical Record

8.1.1 Field 4.001: Logical Record Length (LEN)

This mandatory four-byte field contains the length of this Type-4 record, and specifies the total number of bytes including every byte of every field contained in the record.

8.1.2 Field 4.002: Image Designation Character (IDC)

This mandatory one-byte binary field shall occupy the fifth byte of each record type. It shall be used to identify the image data contained in this record. The IDC contained in this field shall be a binary representation of the IDC found in the file content (CNT) field of the Type-1 record.

8.1.3 Field 4.003: Impression Type (IMP)

The impression type is a single-byte field occupying the sixth byte of the record.

Code	Description
0	Live-scan plain
1	Live-scan rolled
2	Non-live scan plain
3	Non-live scan rolled
4	Latent impression captured directly
5	Latent tracing
6	Latent photo
7	Latent lift
8	Livescan vertical swipe

Code	Description
10	Live-scan palm
11	Nonlive-scan palm
12	Latent palm impression
13	Latent palm tracing
14	Latent palm photo
15	Latent palm lift
20	Live-scan optical contact palm
21	Live-scan optical contact rolled
22	Live-scan non-optical contact plain
23	Live-scan non-optical contact rolled
24	Live-scan optical contactless plain
25	Live-scan optical contactless rolled
26	Live-scan non-optical contactless plain
27	Live-scan non-optical contactless rolled
28	Other
29	Unknown

Table 13 Finger Impression Type

8.1.4 Field 4.004: Finger Position (FGP)

This mandatory fixed-length field of 6 bytes occupies the seventh through twelfth byte positions of a Type-4 record. It contains possible finger positions beginning in the left most byte (byte 7 of the record). The known or most probable finger position is taken from the following table 13. Up to five additional fingers may be referenced by entering the alternate finger positions in the remaining five bytes using the same format. If fewer than five finger position references are to be used the unused bytes are filled with binary 255. To reference all finger positions code 0, for unknown, is used.

Finger position	Finger code	Width (mm)	Length (mm)
Unknown	0	40.0	40.0
Right thumb	1	45.0	40.0
Right index finger	2	40.0	40.0
Right middle finger	3	40.0	40.0
Right ring finger	4	40.0	40.0
Right little finger	5	33.0	40.0
Left thumb	6	45.0	40.0
Left index finger	7	40.0	40.0
Left middle finger	8	40.0	40.0
Left ring finger	9	40.0	40.0
Left little finger	10	33.0	40.0
Plain right thumb	11	30.0	55.0
Plain left thumb	12	30.0	55.0
Plain right four fingers	13	70.0	65.0
Plain left four fingers	14	70.0	65.0
Left & right thumbs	15	81.3	76.2
EJI or tip	19	114.3	127.0

Table 14 Finger position code and maximum size

For scene of crime latents only the codes 0 to 10 should be used.

8.1.5 Field 4.005: Image Scanning Resolution (ISR)

This mandatory one-byte field occupies the 13th byte of a Type-4 record. If it contains "0" then the image has been sampled at the preferred scanning rate of 19.68 pixels/mm (500 pixels per inch). If it contains "1" then the image has been sampled at an alternative scanning rate as specified in the Type-1 record.

8.1.6 Field 4.006: Horizontal Line Length (HLL)

This mandatory field is positioned at bytes 14 and 15 within the Type-4 record. It specifies the width of the image by the number of pixels contained in each scan line. The first byte will be the most significant.

8.1.7 Field 4.007: Vertical Line Length (VLL)

This mandatory field records in bytes 16 and 17 the length of the image by the number of scan lines present in the image. The first byte is the most significant.

8.1.8 Field 4.008: Gray-scale Compression Algorithm (GCA)

This mandatory one-byte binary field shall occupy the eighteenth byte of each record type. It shall be used to specify the type of compression algorithm used (if any). A binary zero denotes no compression. Otherwise, the contents of this byte shall be a binary representation of the number allocated to the particular compression technique used by the interchange parties. The specific code for each algorithm can be found in Table 1 or from the domain registrar who will maintain a registry relating these numbers to the compression algorithms.

- ∉ For the Type-3 logical record, there is no recommendation for a commonly used grayscale compression algorithm;
- ∉ For the Type-4 logical record, the Wavelet Scalar Quantization (WSQ), or the JPEG 10918 standard algorithms are recommended for compressing the high-resolution grayscale data;
- ∉ For Type-5 or Type 6 logical records, the Facsimile ANSI/EIA 538-1988 algorithm is recommended for the lossless compression and decompression of binary fingerprint images.

8.1.9 Field 4.009: The Image

This mandatory final binary field shall contain the image data. Each pixel of the uncompressed grayscale image shall be quantized to eight bits (256 gray levels) contained in a single byte. For the exchange of an uncompressed binary image, eight pixels shall be left justified and packed into a single unsigned byte. The most significant bit of the byte shall be the first of the eight

pixels scanned. If compression is used, the pixel data shall be compressed in accordance with the compression technique specified in the CGA / BCA field.

8.1.10 End of fixed-resolution fingerprint image record

Since each of these logical records is a defined and specified series of binary data fields, no additional bytes shall be transmitted to signify the end of this logical record type. This completes the description of a Type-3 through Type-6 fixed-resolution fingerprint image records.

8.1.11 Additional fixed-resolution fingerprint image records

Typically, for each of these logical record types, there may be up to thirteen additional images contained within the transaction file. For each additional image, a logical record is required.

9 Type-7 Logical Record: User-defined Image

Type-7 records are intended for user-defined image information relating to the subject of a transaction. For Interpol purposes this logical record is likely to fall into two categories, either:

- ∉ High resolution image data of the
  - palms of the hands
  - fingertips
  - soles and toes of the feet

or

- ∉ Other image data.

The category to which each record belongs is defined by IMT (Field 7.003).

When used for Category-1 data, there may be multiple Type-7 records in a file. These records contain high resolution image data that have been captured at the nominal scanning resolution of 500 pixels per inch. They are quantized to eight-bits (i.e. 256-level grey scale), a value of zero being used to define a black pixel and an unsigned value of 255 to define a white pixel.

When used for Category-2 data there may be up to six of these Type-7 records in a file. The scanning resolution used to capture the data is specified by IMR (Field 7.006).

When there are one or more Type-7 logical records, entries are provided in ten ordered and unnumbered mandatory fields. The first nine are fixed in length and total 33 bytes. These nine fields precede the image data contained in field 7.010

9.1 Fields for Type-7 Logical Record

9.1.1 Field 7.001: Logical Record Length (LEN)

This mandatory four-byte field contains the length of the logical record, specifying the total number of bytes including every byte of all the fields contained in the record.

9.1.2 Field 7.002: Image Designation Character (IDC)

This mandatory one-byte binary field shall occupy the fifth byte of a Type-7 record. It shall be used to identify the image data contained in this record. The IDC contained in this field shall be a binary representation of the IDC found in the file content (CNT) field of the Type-1 record.

9.1.3 Field 7.003: Image Type (IMT)

The sixth byte contains a one-byte identifier which specifies whether the image is of Category-1 (palm, finger-tips, sole and toe data) or Category-2 (other) data. The permissible values of this field are:

1 Category-1
2 Category-2

9.1.4 Field 7.004: Image Description (IMD)

This one-byte field occupies the seventh byte position of a Type-7 record. The field contains a code selected from the following table.

Image description	Code
unknown	20
palm print, left hand	21
outside edge, left hand	22
inside edge, left hand	23
wrist, left hand	24
palm print, right hand	25
outside edge, right hand	26
inside edge, right hand	27
wrist, right hand	28
sole, left foot	29
toes, left foot	30
sole, right foot	31
toes, right foot	32
part 1 of a ten-print form	41
part 2 of a ten-print form	42
part 3 of a ten-print form	43
part 4 of a ten-print form	44
part 5 of a ten-print form	45
part 6 of a ten-print form	46
the complete ten-print form	47
other image	50
fingertip of right thumb	60
fingertip of right index finger	61
fingertip of right middle finger	62
fingertip of right ring finger	63
fingertip of right little finger	64
fingertip of left thumb	65
fingertip of left index finger	66
fingertip of left middle finger	67
fingertip of left ring finger	68
fingertip of left little finger	69

Table 15 Image Description

9.1.5 Field 7.005: Pattern Classification (PCN)

When the Type-7 record is used for Category-1 image data, this field, of length ten bytes, contains the pattern classification of the image, in any agreed format. If no classification is to be included in the record, then these ten bytes contain binary zeros.

When the Type-7 record is used for Category-2 image data, these ten bytes contain zeros.

9.1.6 Field 7.006: Image Capture Resolution (IMR)

This field of length eleven bytes consists of three subfields, starting at byte number 18.

When the Type-7 record is used for Category-1 image data, this field contains binary zeros.

When the Type-7 record is used for Category-2 image data, the three subfields consist of:

1 The scanning resolution of the captured image in pixels per 100mm (2 bytes)
2 The number of bytes which represent each pixel, up to a maximum of four (1 byte)
3 The value defining white pixels and the value defining black pixels (4 bytes each, most significant first, unused bytes filled with zeros)

Scanning resolution is specified in units of pixels per 100mm using two bytes, the first being the most significant. For example 7,176 represents (256*7)+176 = 1968, equivalent to 19.68 pixels per mm (500 pixels per inch).

9.1.7 Field 7.007: Horizontal Line Length (HLL)

This two-byte field occupies the 29th and 30th byte positions of the Type-7 record. It is used to specify the number of pixels contained in a single line scan of the image. The first byte is the most significant.

9.1.8 Field 7.008: Vertical Line Length (VLL)

This two-byte field occupies the 31st and 32nd byte positions of the Type-7 record. It is used to specify the number of scan lines contained in the image. The first byte is the most significant.

9.1.9 Field 7.009: Gray-scale Compression Algorithm (GCA)

This one-byte field occupies the 33rd byte of the record. It is used to specify the type of gray-scale compression algorithm used (if any). A binary zero denotes no compression. In this case the scan sequence is left to right and top to bottom. Otherwise, the contents of this field is a binary representation of the number allocated to the particular compression technique used by the interchange parties. The FBI will maintain a registry relating these numbers to the compression algorithms. Interpol will use the same allocation of numbers.

9.1.10 Field 7.010: Image Data

This field contains a byte stream representing all of the gray-scale image data. It commences at the 34th byte of the record.

10 Type-8 Logical Record: Signature Image

Type-8 logical records shall contain either scanned or vectored signature data. Each Type-8 record shall cover an area of up to 1000 mm2.

If scanned, the resolution shall be the minimum scanning resolution or the native scanning resolution, and the scan sequence shall be left to right and top to bottom. The scanned data shall be a binary representation quantized to two levels.

If vectored signature data is present, it shall be expressed as a series of binary numbers.

10.1 Fields for Type-8 Logical Record

When one or two Type-8 logical records are used, entries shall be provided in eight ordered and unnumbered binary fields for each signature record. Table 15 provides a list of the fields for the Type-8 logical record. The first seven fields are fixed length and shall total twelve bytes. These fields shall precede the image data contained in field eight. The size of field eight is determined from the LEN field of the record itself. The image data field is 12 bytes less than the value specified in the LEN field.

Field number	Tag	Field Description	Byte Count	Byte Position
1	LEN	Logical record lenght	4	1-4
2	IDC	Image designation character	1	5
3	SIG	Signature type	1	6
4	SRT	Signature representation character	1	7
5	ISR	Image scanning resolution	1	8
6	HLL	Horizontal line lenght	2	9-10
7	VLL	Vertical line length	2	11-12
8	DATA	Signature image data	<LEN> - 12	13 through <LEN>

Table 16

10.1.1 Field 8.001: Logical Record Length (LEN)

This mandatory four-byte binary field shall occupy bytes one through four. It shall contain the length of the logical record expressed as the total number of bytes, including every byte of all eight fields contained in the record.

10.1.2 Field 8.002: Image Designation Character (IDC)

This mandatory one-byte binary field shall occupy the fifth byte of the Type-8 record. It shall be used to identify the image data contained in the Type-8 record. The IDC contained in this field shall be a binary representation of the IDC found in the file content (CNT) field of the Type-1 record.

10.1.3 Field 8.003: Signature Type (SIG)

The sixth byte contains the signature type field. The permissible values of this field are:

0 The signature is that of the fingerprinted subject
1 The signature is that of the fingerprinting officer.

10.1.4 Field 8.004: Signature Representation Type (SRT)

This field indicates how the signature is stored, and is located at the seventh byte of the record. The permissible values of this field are:

0 The image is uncompressed
1 The image is compressed
2 The image is vector data.

10.1.5 Field 8.005: Image Scanning Resolution (ISR)

This mandatory field gives the image scanning resolution in pixels per mm. One byte is required, in the eighth position of the Type-8 record.

The format is a binary zero if the minimum scanning resolution is used and a one if the native scanning resolution is used. A zero shall also be recorded if the image is in vector format.

10.1.6 Field 8.006: Horizontal Line Length (HLL)

This mandatory field occupies the ninth and 10th byte of the Type-8 record. For binary images it specifies the number of pixels per scan line in the image. For vectorized signature data both bytes contain the value "0000 0000". The first byte is the most significant.

10.1.7 Field 8.007: Vertical Line Length (VLL)

This mandatory two-byte field indicates the number of scan lines present in a binary image and is positioned at bytes 11 and 12 within the record. As with HLL (Field 8.006) it contains zeros if the signature is in vector representation. The first byte is the most significant.

10.1.8 Field 8.008: Signature Data

This mandatory field shall contain uncompressed scanned image signature data, compressed scanned image signature data, or vectored image signature data. The entry contained in the SRT field shall indicate which form of the signature data is present.

10.1.8.1 Uncompressed scanned image data

If the SRT field contains the binary value of “0”, then this field shall contain the uncompressed scanned binary image data for the signature. In uncompressed mode, the data shall be packed at eight pixels per byte.

10.1.8.2 Compressed scanned image data

If the SRT field contains the binary value of “1”, then this field shall contain the scanned binary image data for the signature in compressed form using the ANSI/EIA-538-1988 facsimile compression algorithm.

10.1.8.3 Vectored image data

If the SRT field contains the binary equivalent of “2”, then this field shall contain a list of vectors describing the pen position and pen pressure of line segments within the signature. Each vector shall consist of five bytes.

The first two bytes of each vector shall contain the unsigned binary X coordinate of the pen position with the high order byte containing the most significant bits. The next two bytes shall contain the unsigned Y coordinate using the same convention to denote the most significant bits. Both the X and Y coordinates shall be expressed in units of .0254 mm (.001 inches) referenced from the bottom leftmost corner of the signature. Positive values of X shall increase from left-to-right and positive values of Y shall increase from bottom-to-top.

An unsigned binary number between “0” and “255” contained in the fifth byte shall represent the pen pressure. This shall be a constant pressure until the next vector becomes active. A binary value or pressure of “0” shall represent a "pen-up" (or no pressure) condition. The binary value of “1” shall represent the least recordable pressure for a particular device, while the binary equivalent of “254” shall represent the maximum recordable pressure for that device. To denote the end of the vector list the binary equivalent of “255” shall be inserted in this entry.

10.2 End of Type-8 signature image record

Since the Type-8 logical record is a defined and specified series of binary data fields, no additional bytes shall be transmitted to signify the end of this logical record type.

10.3 Additional signature

One more signature may be described within the file. For an additional signature, a Type-8 logical record is required.

11 Type-9 Logical Record: Minutiæ Record

Type-9 records shall contain ASCII text describing minutiæ and related information encoded from a finger, palm or latent. For a tenprint search transaction, there may be up to ten of these Type-9 records in a file, each of which shall be for a different finger. There may be up to four of these records for palm print searches. The Type-9 record shall also be used to exchange the minutiæ information from latent finger or palm images between similar or different systems.

11.1 Minutiæ and Other Information Descriptors

11.1.1 Minutia Type Identification

This standard defines three identifier numbers that are used to describe the minutia type. Theseare listed in Table 4.1. A ridge ending shall be designated Type 1. A bifurcation shall be designated Type 2. If a minutia cannot be clearly categorized as one of the above two types, it shall be designated as “other”, Type 0.

Type	Description
0	Other
1	Ridge ending
2	Bifurcation

Table 17 Minutia types

11.1.2 Minutia placement and type

For templates to be compliant with Section 5 of the ANSI INCITS 378-2004 standard, the following method, which enhances the current INCITS 378-2004 standard, shall be used for determining placement (location and angular direction) of individual minutiae.
The position or location of a minutia representing a ridge ending shall be the point of forking of the medial skeleton of the valley area immediately in front of the ridge ending. If the three legs of the valley area were thinned down to a single-pixel-wide skeleton, the point of the intersection is the location of the minutia. Similarly, the location of the minutia for a bifurcation shall be the point of forking of the medial skeleton of the ridge. If the three legs of the ridge were each thinned down to a single-pixel-wide skeleton, the point where the three legs intersect is the location of the minutia.
After all ridge endings have been converted to bifurcations, all of the minutiae of the fingerprint image are represented as bifurcations. The X and Y pixel coordinates of the intersection of the three legs of each minutia can be directly formatted. Determination of the minutia direction can be extracted from each skeleton bifurcation. The three legs of every skeleton bifurcation must be examined and the endpoint of each leg determined. Figure 4.1 illustrates the three methods used for determining the end of a leg that is based on a scanning resolution of 500 ppi.

The ending is established according to the event that occurs first. The pixel count is based on a scan resolution of 500 ppi. Different scan resolutions would imply different pixel counts.
∉ A distance of .064" (the 32nd pixel)

- The end of skeleton leg that occurs between a distance of .02" and .064" (the 10th through the 32nd pixels); shorter legs are not used
- A second bifurcation is encountered within a distance of .064" (before the 32nd pixel)

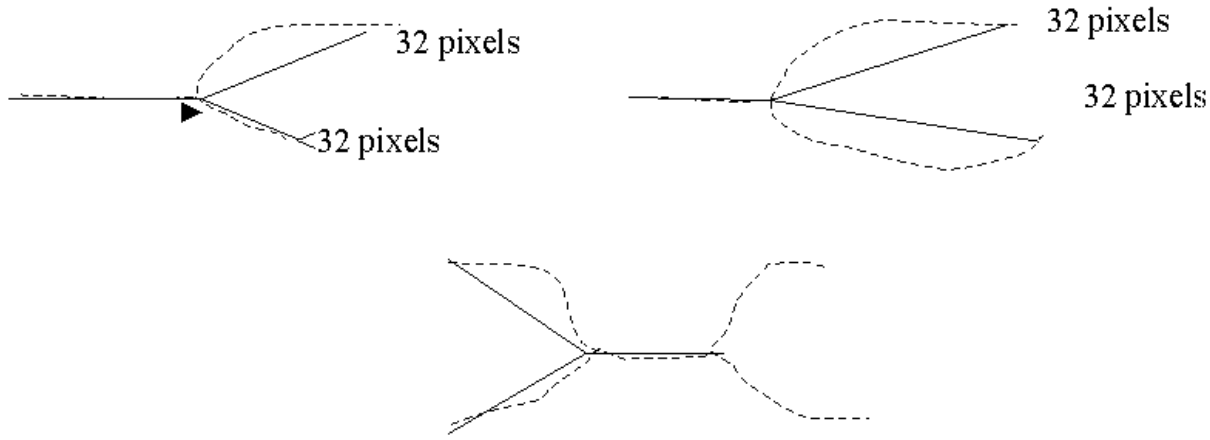

Figure 1 1

The angle of the minutiae is determined by constructing three virtual rays originating at the bifurcation point and extending to the end of each leg. The smallest of the three angles formed by the rays is bisected to indicate the minutiae direction.

11.1.2 Coordinate system

The coordinate system used to express the minutiae of a fingerprint shall be a Cartesian coordinate system. Minutiae locations shall be represented by their x and y coordinates. The origin of the coordinate system shall be the upper left corner of the original image with x increasing to the right and y increasing downward. Both x and y coordinates of a minutiae shall be represented in pixel units from the origin. It should be noted that the location of the origin and units of measure is not in agreement with the convention used in the definitions of the Type 9 in the ANSI/NIST-ITL 1-2000.

11.1.2 Minutiæ direction

Angles are expressed in standard mathematical format, with zero degrees to the right and angles increasing in the counterclockwise direction. Recorded angles are in the direction pointing back along the ridge for a ridge ending and toward the center of the valley for a bifurcation. This convention is 180 degrees opposite of the angle convention described in the definitions of the Type 9 in the ANSI/NIST-ITL 1-2000.

11.2 Fields for Type-9 Logical record INCITS-378 Format

All fields of the Type-9 records shall be recorded as ASCII text. No binary fields are permissible in this tagged-field record.

11.2.1 Field 9.001: Logical record length (LEN)

This mandatory ASCII field shall contain the length of the logical record specifying the total number of bytes, including every character of every field contained in the record.

11.2.2 Field 9.002: Image designation character (IDC)

This mandatory two-byte field shall be used for the identification and location of the minutiæ data. The IDC contained in this field shall match the IDC found in the file content field of the Type-1 record.

11.2.3 Field 9.003: Impression type (IMP)

This mandatory one-byte field shall describe the manner by which the fingerprint image information was obtained. The ASCII value of the proper code as selected from Table 3.1 shall be entered in this field to signify the impression type.

11.2.4 Field 9.004: Minutiæ format (FMT)

This field shall contain a "U" to indicate that the minutiae are formatted in M1-378 terms. Even though information may be encoded in accordance with the M1-378 standard, all data fields of the Type-9 record must remain as ASCII text fields.

11.2.5 Field 9.126: CBEFF information

This field shall contain three information items. The first information item shall contain the value "27" (0x1B). This is the identification of the CBEFF Format Owner assigned by the International Biometric Industry Association (IBIA) to INCITS Technical Committee M1. The <US> character shall delimit this item from the CBEFF Format Type that is assigned a value of "513" (0x0201) to indicate that this record contains only location and angular direction data without any Extended Data Block information. The <US> character shall delimit this item from the CBEFF Product Identifier (PID) that identifies the "owner" of the encoding equipment. The vendor establishes this value. It can be obtained from the IBIA website (www.ibia.org) if it is posted.

11.2.6 Field 9.127: Capture equipment identification

This field shall contain two information items separated by the <US> character. The first shall contain "APPF" if the equipment used originally to acquire the image was certified to comply with Appendix F (IAFIS Image Quality Specification, January 29, 1999) of CJIS-RS-0010, the Federal Bureau of Investigation's Electronic Fingerprint Transmission Specification. If the equipment did not comply it will contain the value of "NONE". The second information item

shall contain the Capture Equipment ID which is a vendor-assigned product number of the capture equipment. A value of "0" indicates that the capture equipment ID is unreported.

11.2.7 Field 9.128: Horizontal line length (HLL)

This mandatory ASCII field shall contain the number of pixels contained on a single horizontal line of the transmitted image. The maximum horizontal size is limited to 65,534 pixels.

11.2.8 Field 9.129: Vertical line length (VLL)

This mandatory ASCII field shall contain the number of horizontal lines contained in the transmitted image. The maximum vertical size is limited to 65,534 pixels.

11.2.9 Field 9.130: Scale units (SLC)

This mandatory ASCII field shall specify the units used to describe the image sampling frequency (pixel density). A "1" in this field indicates pixels per inch, or a "2" indicates pixels per centimeter. A "0" in this field indicates no scale is given. For this case, the quotient of HPS/VPS gives the pixel aspect ratio.

11.2.10 Field 9.131: Horizontal pixel scale (HPS)

This mandatory ASCII field shall specify the integer pixel density used in the horizontal direction providing the SLC contains a "1" or a "2". Otherwise, it indicates the horizontal component of the pixel aspect ratio.

11.2.11 Field 9.132: Vertical pixel scale (VPS)

This mandatory ASCII field shall specify the integer pixel density used in the vertical direction providing the SLC contains a "1" or a "2". Otherwise, it indicates the vertical component of the pixel aspect ratio.

11.2.12 Field 9.133: Finger view

This mandatory field contains the view number of the finger associated with this record's data. The view number begins with "0" and increments by one to "15".

11.2.13 Field 9.134: Finger position (FGP)

This field shall contain the code designating the finger position that produced the information in this Type-9 record. A code between 1 and 10 taken from table 3.2 or the appropriate palm code from table 6.3 shall be used to indicate the finger or palm position.

11.2.14 Field 9.135: Finger quality

The field shall contain the quality of the overall finger minutiæ data and shall be between 0 and 100. This number is an overall expression of the quality of the finger record, and represents quality of the original image, of the minutia extraction and any additional operations that may affect the minutiæ record.

11.2.15 Field 9.136: number of minutiæ

The mandatory field shall contain a count of the number of minutiæ recorded in this logical record.

11.2.16 Field 9.137: Finger minutiæ data

This mandatory field has six information items separated by the <US> character. It consists of several subfields, each containing the details for a single minutiae. The total number of minutiae subfields must agree with the count found in field 136. The first information item is the minutiae index number, which shall be initialized to "1" and incremented by "1" for each additional minutia in the fingerprint. The second and third information items are the 'x' coordinate and 'y' coordinates of the minutiae in pixel units. The fourth information item is the minutiae angle recorded in units of two degrees. This value shall be nonnegative between 0 and 179. The fifth information item is the minutiae type. A value of "0" is used to represent a minutiae of type "OTHER", a value of "1" for a ridge ending and a value of "2" for a ridge bifurcation. The sixth information item represents the quality of each minutiae. This value shall range from 1 as a minimum to 100 as a maximum. A value of "0" indicates that no quality value is available. Each subfield shall be separated from the next with the use of the <RS> separator character.

11.2.17 Field 9.138: Ridge count information

This field shall consist of a series of subfields each containing three information items. The first information item of the first subfield shall indicate the ridge count extraction method. A "0“ indicates that no assumption shall be made about the method used to extract ridge counts, nor their order in the record. A "1" indicates that for each center minutiae, ridge count data was extracted to the nearest neighboring minutiae in four quadrants, and ridge counts for each center minutia are listed together. A "2" indicates that for each center minutiae, ridge count data was extracted to the nearest neighboring minutiae in eight octants, and ridge counts for each center minutia are listed together. The remaining two information items of the first subfield shall both contain "0". Information items shall be separated by the <US> separator character. Subsequent subfields will contain the center minutiae index number as the first information item, the neighboring minutiae index number as the second information item, and the number of ridges crossed as the third information item. Subfields shall be separated by the <RS> separator character.

11.2.18 Field 9.139: Core information

This field will consist of one subfield for each core present in the original image. Each subfield consists of three information items. The first two items contains the 'x' and 'y' coordinates positions in pixel units. The third information item contains the angle of the core recorded in units of 2 degrees. The value shall be a nonnegative value between 0 and 179. Multiple cores will be separated by the <RS> separator character.

11.2.19 Field 9.140: Delta information

This field will consist of one subfield for each delta present in the original image. Each subfield consists of three information items. The first two items contains the 'x' and 'y' coordinates positions in pixel units. The third information item contains the angle of the delta recorded in units of 2 degrees. The value shall be a nonnegative value between 0 and 179. Multiple cores will be separated by the <RS> separator character.

12 Type-10 Logical Record: Facial and/or SMT Binary Image Record

Type-10 records shall contain facial and/or SMT binary image data and related ASCII information pertaining to the specific image contained in this record. It shall be used to exchange both grayscale and color image data. Image data contained in the Type-10 record may be uncompressed or compressed.

12.1 Fields for Type-10 logical record

Table 17 lists each of the mandatory and optional fields present in a Type-10 logical record. The following paragraphs describe the data contained in each of the fields for the Type-10 logical record.

Within a Type-10 logical record, entries shall be provided in numbered fields. It is required that the first two fields of the record are ordered, and the field containing the image data shall be the last physical field in the record. For each field of the Type-10 record, Table 17 lists the "condition code" as being mandatory "M" or optional "O", the field number, the field name, character type, field size, and occurrence limits. Based on a three digit field number, the maximum byte count size for the field is given in the last column. As more digits are used for the field number, the maximum byte count will also increase. The two entries in the "field size per occurrence" include all character separators used in the field. The "maximum byte count" includes the field number, the information, and all the character separators. Fields containing entries in the "IMG" column are only applicable to that image type. An entry of "FAC" applies to a mugshot or facial image,
and an entry of "SMT" applies to scar, a mark, or a tattoo image.

12.1.1 Field 10.001: Logical Record Length (LEN)

This mandatory ASCII field shall contain the total count of the number of bytes in the Type-10 logical record. Field 10.001 shall specify the length of the record including every character of every field contained in the record and the information separators. The *"GS"* character shall separate the length code of Field 10.001 from the next field.

12.1.2 Field 10.002: Image Designation Character (IDC)

This mandatory one to four byte ASCII field shall be used to identify the facial or SMT image data contained in the record. This IDC shall match the IDC found in the file content (CNT) field of the Type-1 record.

Ident	Cond. code	Field Number	Field Name	IMG	Char type	Field size per occurrence		Occur count		Max byte count
						min.	max.	min	max	
LEN	M	10.001	LOGICAL RECORD LENGTH		N	4	8	1	1	15
IDC	M	10.002	IMAGE DESIGNATION		N	2	5	1	1	12

Ident	Cond. code	Field Number	Field Name	IMG	Char type	Field size per occurrence		Occur count		Max byte count
						min.	max.	min	max	
			CHARACTER							
IMT	M	10.003	IMAGE TYPE		A	5	7	1	1	14
SRC	M	10.004	SOURCE AGENCY / ORI		AN	6	35	1	1	42
PHD	M	10.005	PHOTO DATE		N	9	9	1	1	16
HLL	M	10.006	HORIZONTAL LINE LENGTH		N	4	5	1	1	12
VLL	M	10.007	VERTICAL LINE LENGTH		N	4	5	1	1	12
SLC	M	10.008	SCALE UNITS		N	2	2	1	1	9
HPS	M	10.009	HORIZONTAL PIXEL SCALE		N	3	5	1	1	12
VPS	M	10.010	VERTICAL PIXEL SCALE		N	3	5	1	1	12
CGA	M	10.011	COMPRESSION ALGORITHM		A	5	7	1	1	14
CSP	M	10.012	COLOR SPACE		A	4	5	1	1	12
SAP	M	10.013	SUBJECT ACQUISITION PROFILE							
RSV	-	10.014 10.015	RESERVED FOR FUTURE INCLUSION		--	--	--	--	--	--
SHPS	O	10.016	SCAN HOR PIXEL SCALE		N	2	5	0	1	12
SVPS	O	10.017	SCAN VER PIXEL SCALE		N	2	5	0	1	12
RSV	-	10.018 10.019	RESERVED FOR FUTURE DEFINITION		--	--	--	--	--	--
POS	O	10.020	SUBJECT POSE	FAC	A	2	2	0	1	9
POA	O	10.021	POSE OFFSET ANGLE	FAC	N	2	5	0	1	12
PXS	O	10.022	PHOTO DESCRIPTION	FAC	A	4	21	0	9	196
PAS	O	10.023	PHOTO ACQUISITION SOURCE	FAC	A	7	15	0	1	22
SQS	O	10.024	SUBJECT QUILITY SCORE	FAC	N	10	35	0	9	322
SPA	O	10.025	SUBJECT POSE ANGLES	FAC	N	9	23	0	1	30
SXS	O	10.026	SUBJECT FACIAL DESCRIPTION	FAC	A	6	21	0	50	1057
SEC	O	10.027	SUBJECT EYE COLOR	FAC	A	4	4	0	1	11
SHC	O	10.029	SUBJECT HAIR COLOR	FAC	A	4	8	0	2	15
SFP	O	10.029	FACIAL FEATURE POINTS	FAC	N	10	18	0	88	1591
DMM	O	10.030	DEVICE MONITORING MODE	FAC	A	8	11	0	1	18
RSV	-	10.031 10.039	RESERVED FOR FUTURE INCLUSION		--	--	--	--	--	--
SMT	M	10.040	NCIC DESIGNATION CODE	SMT	A	4	11	1	3	40
SMS	O	10.041	SCAR/MARK/TATTOO SIZE	SMT	N	4	6	0	1	13
SMD	O	10.042	SMT DESCRIPTORS	SMT	AN	16	51	0	9	466
COL	O	10.043	COLORS PRESENT	SMT	A	4	21	0	9	196
RSV	-	10.044 10.199	RESERVED FOR FUTURE INCLUSION		--	--	--	--	--	--
UDF	O	10.200 10.998	USER DEFINED FIELDS		--	--	--	--	--	--
DAT	M	10.999	IMAGE DATA		B	2	5,000,001	1	1	5,000,008

Table 18 Type-10 facial and SMT record layout

Key for condition code: M = Mandatory; O = Optional
Key for character type: N = Numeric; A = Alphabetic; AN = Alphanumeric; B = Binary

12.1.3 Field 10.003: Image Type (IMT)

This mandatory ASCII field is used to indicate the type of image contained in this record. It shall contain "*FACE*", "*SCAR*", "*MARK*", or "*TATTOO*" to indicate a face, scar, mark or tattoo image.

12.1.4 Field 10.004: Source Agency / ORI (SRC)

This mandatory ASCII field shall contain the identification of the administration or organization that originally captured the facial image contained in the record. Normally, the Originating Agency Identifier (ORI) of the agency that captured the image will be contained in this field. It consists of two information items in the following format

CC/*agency.*

The first information item contains the Interpol Country Code, two alpha-numeric characters long. The second item, *agency*, is a free text identification of the agency, up to a maximum of 32 alpha-numeric characters.

12.1.5 Field 10.005: Photo Date (PHD)

This mandatory ASCII field shall contain the date that the facial or SMT image contained in the record was captured. The date shall appear as eight digits in the format *YYYYMMDD*. The *YYYY* characters shall represent the year the image was captured; the *MM* characters shall be the tens and units values of the month; and the *DD* characters shall be the tens and units values of the day in the month. For example, 20040229 represents February 29, 2004. The complete date must be a legitimate date.

12.1.6 Field 10.006: Horizontal Line Length (HLL)

This mandatory ASCII field shall contain the number of pixels contained on a single horizontal line of the transmitted image.

12.1.7 Field 10.007: Vertical Line Length (VLL)

This mandatory ASCII field shall contain the number of horizontal lines contained in the transmitted image.

12.1.8 Field 10.008: Scale Units (SLC)

This mandatory ASCII field shall specify the units used to describe the image sampling frequency (pixel density). A "1" in this field indicates pixels per inch, or a "2" indicates pixels per centimeter. A "0" in this field indicates no scale is given. For this case, the quotient of HPS/VPS gives the pixel aspect ratio.

12.1.9 Field 10.009: Horizontal Pixel Scale (HPS)

This mandatory ASCII field shall specify the pixel density used in the horizontal direction providing the SLC contains a "1" or a "2". Otherwise, it indicates the horizontal component of the pixel aspect ratio.

12.1.10 Field 10.010: Vertical Pixel Scale (VPS)

This mandatory ASCII field shall specify the pixel density used in the vertical direction providing the SLC contains a "1" or a "2". Otherwise, it indicates the vertical component of the pixel aspect ratio.

12.1.11 Field 10.011: Compression Algorithm (CGA)

This mandatory ASCII field shall contain an entry from Table 1 (other than WSQ) to specify the algorithm used for compressing the color or grayscale image. An entry of *"NONE"* in this field indicates that the data contained in this record is uncompressed. The image shall be represented as an array of n rows by m columns by at least 8-bit pixels. Each pixel in a monochrome image shall be represented by eight or more bits. Color images shall be represented as a series of sequential samples of a red, green, and blue intensity for each pixel. The image shall be organized in row-major order, with the lowest address corresponding to the upper left corner of the image. For those images that are to be compressed, the method for the compression of facial and SMT images is specified by the baseline mode of the JPEG, JPEG 2000, or PNG algorithms.

12.1.12 Field 10.012: Colorspace (CSP)

This mandatory ASCII field shall contain an entry from Table 3 to identify the color space used to exchange the image data. If the color space for an RGB image cannot be determined, an entry of "RGB" shall be entered in field 10.012.

For JPEG-compressed color image files (stored using the JFIF file format), the preferred (external) color space is sRGB and an entry of “SRGB” shall be used for Field 10.012. For all grayscale (monochrome) images, an entry of "GRAY" shall be used for Field 10.012.

For JPEG 2000 images stored using the JP2 file format, the available enumerated color spaces are sRGB, sYCC, and grayscale, to be entered, respectively, as “SRGB”, “SYCC”, and “GRAY” in Field 10.012. The preferred (external) color space for color images is sRGB. If a photo acquisition device uses another ICC13 color profile, the acquisition system must convert the image data to one of these enumerated color spaces before the JP2 file may be embedded in a Type 10 record.

For uncompressed color images containing non-interleaved red, green, and blue pixels in that order, the preferred color space is sRGB and an entry of “SRGB” shall be used for Field 10.012.

Note that the field codes do not determine if the image data is JPEG, JPEG 2000, or uncompressed color images. Field 10.011 will need to be examined to make that determination.

12.1.13 Field 10.013: Subject Acquisition Profile (SAP)

The Subject Acquisition Profile (SAP) is a mandatory ASCII text field when field 10.003 contains "FACE". The intent of this field is to provide a general description of the criteria under which the facial image was captured. This field shall contain an ASCII character code selected from Table 18 to indicate the numeric value of the acquisition profile and conditions used to acquire the image. Typically, the higher the value, the stronger the acquisition requirements become. Therefore, in the text below, the SAP value will also be denoted as a "level".

Together with Table 18 is a brief description of each of the levels. Note that levels 10 to 15 denote transactions associated with image acquisition under the guidance of other facial standards or application profiles. Levels 30 to 51 reference best practice recommendations consisting of increasingly more stringent requirements that must be satisfied. Additional details and criteria for these levels are contained in Annex H and Annex I.

Subject Acuisition Profile	Attribute Level Code
Unknown profile	0
Surveillance facial image	1
Driver´s licence image (AAMVA)	10
ANSI Full Frontal image (ANSI 385)	11
ANSI Token facial image (ANSI 385(	12
ISO Full Frontal facial image (ISO/IEC 19794-5)	13
ISO Token facial image (ISO/IEC 19794-5)	14
PIV facial image (NIST SP 800-76)	15
Legacy Mugshot	20
Best Practice Application – Level 30	30
Best Practice Application – Level 40	40
Best Practice Application – Level 50	50
Best Practice Application – Level 51	51

12.1.13.1 Level 0 (Unknown profile)

This level denotes any case when the Subject Acquisition Profile is unknown. This value can be used to alert systems that the profile of the face image needs to be determined manually or via advanced face image quality evaluation techniques.

Level 1 (Surveillance facial image)

This SAP denotes a surveillance facial image: a face image captured without specific regard to scene, photographic, or digital requirements. For example, an image of a face from commonly available surveillance video equipment is generally considered a surveillance facial image. Typically surveillance facial images are of relatively poor quality compared to mugshots, including significant pose angle used for the frontal view, poor image resolution, poor image contrast, etc.

12.1.13.2 Levels 10-15 (Other application profiles)

Levels 10-15 shall denote transaction associated with capture under the guidance of other facial standards or application profiles as defined below.

- Level 10 denotes a driver license facial portrait described in the AAMVA International Specification – DL/ID Card Design
- Level 11 denotes an ANSI facial image which meets requirements of the Full Frontal Image type defined in ANSI INCITS 385-2004
- Level 12 denotes an ANSI facial image which meets requirements of the Token Face Image type defined in ANSI INCITS 385-2004
- Level 13 denotes an ISO facial image that meets the requirements of the Full Frontal Image defined in International standard ISO/IEC 19794-5
- Level 14 denotes an ISO facial image that meets the requirements of the Token Face Image type defined in International standard ISO/IEC 19794-5
- Level 15 denotes a PIV facial image which meets requirements of Biometric Data Specification for Personal Identity Verification.

Note that the facial images of Levels 13 and 14 may come from travel documents as described in "Deployment of Machine Readable Travel Documents'', ICAO Technical Report, version 2.0 .

12.1.13.3 Level 20 (Legacy facial mugshot)

A transaction conforming to this application profile level shall be a mugshot formatted according to ANSI/NIST-ITL 2000, but not necessarily or known to be conforming to the best practice requirements given in profile 30 below. The subject pose(s) can be Frontal, Profile, or Angled.

12.1.13.4 Best Practice Application Level 30

A transaction conforming to a level 30 application profile shall include at least one mugshot record conforming to all best practice requirements (BPR) in Annex H. These mugshots shall adhere to strict background, lighting, and resolution requirements. In particular, the background is 18% gray, the lighting is three-point, and the image size is at least 480x600 pixels with an aspect ratio of 1:1.25.

12.1.13.5 Best Practice Application Level 40

A facial image conforming to the level 40 application profile can be captured with an off-the shelf 1 megapixel camera. Annex I contains detailed information for the capture of level 40, 50, and 51 facial images. Requirements for conformance with level 40 facial image capture include the following:

- Conformance to the minimum requirements for the capture of level 30 facial images
- At least one frontal face image shall be captured which conforms to the "face image capture requirements"
- The minimum number of pixels in the electronic digital image shall be 768 pixels in the horizontal direction by 1024 pixels in the vertical direction and
- Facial images shall conform to the "head and shoulders" composition detailed requirements. It should be noted that the image quality of the captured facial images will

be improved as the number of pixels in both directions are increased. However, as images are captured with an increased number of pixels, the 3:4 (Width:Height) aspect ratio shall be maintained.

12.1.13.6 Best Practice Application Level 50 and Level 51

A transaction conforming to the level 50 and level 51 application profiles shall include “face image capture requirements” as described in Annex I. These profile levels are intended to allow for examination of up to forensic-level (10 ppmm) detail on a subject’s face. The only difference between levels 50 and 51 is that level 50 specifies the “head and shoulders” composition requirements while level 51 specifies the “head only” composition requirements.

Identification applications require approximately 1700 pixels wide by 2515 pixels high on the face for the 99th percentile male in the U.S. population. Allocating 50% of the image width for the head requires approximately 3400 pixels for a “head and shoulders photo” image width. For a level 50 image capture profile, the minimum number of pixels in the electronic digital image shall be 3300 pixels in the horizontal direction by 4400 pixels in the vertical direction. Off-the-shelf 15 (or more) megapixel digital cameras satisfy this requirement.

As an alternative, allocating 70% of the image width for the head requires approximately 2400 pixels for the “head only” facial capture. For a level 51 image capture profile, the minimum number of pixels in the electronic digital image shall be 2400 pixels in the horizontal direction by 3200 pixels in the vertical direction. Off-the-shelf 8 megapixel digital cameras satisfy this requirement.

The level 50 and level 51 SAPs allow for the encoding of very high resolution face images that are consistent with the discussion above and with the “face image capture requirements”. It should be noted that the image quality of the captured facial images may be improved as the number of pixels in both directions are increased. Figure 4 illustrates the improvement in image quality from levels 30 to 50/51. However, as images are captured with an increased number of pixels, the 3:4 (Width:Height) aspect ratio shall be maintained.

12.1.14 Field 10.014-.015: Reserved for Future Definition (RSV)

These fields are reserved for inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

12.1.15 Field 10.016: Scanned horizontal pixel scale (SHPS)

This optional ASCII field shall specify the horizontal pixel density used for the scanning of the image providing the SLC field contains a "1" or a "2". Otherwise, it indicates the horizontal component of the pixel aspect ratio.

12.1.16 Field 10.017: Scanned vertical pixel scale (SVPS)

This optional ASCII field shall specify the vertical pixel density used for the scanning of the image providing the SLC field contains a "1" or a "2". Otherwise, it indicates the vertical component of the pixel aspect ratio.

12.1.17 Field 10.018-019: Reserved for future definition (RSV)

These fields are reserved for definition and inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

12.1.18 Field 10.020: Subject Pose (POS)

This optional field is to be used for the exchange of facial image data. When included, this field shall contain one ASCII character code selected from Table 20 to describe the pose of the subject. For the angled pose entry "A", field 10.021 shall contain the offset angle from the full face orientation. For the determined 3D pose entry "D", Field 10.025 shall contain a set of determined 3D pose angles (i.e., Yaw, Pitch, and Roll angles) away from the full frontal face orientation. Note that the offset angle in Field 10.021 is opposite from the yaw angle in Field 10.025 as indicated by a minus sign.

Pose description	Pose code
Full Face Frontal	F
Right Profile (90 degree)	R
Left Profile (90 degree)	L
Angled Pose	A
Determined 3D pose	D

Table 19 Subject pose

12.1.19 Field 10.021: Pose Offset Angle (POA)

This field shall only be used for the exchange of facial image data if Field 10.020 (POS) contains an "A" to indicate an angled pose of the subject. This field should be omitted for a full face or a profile. This ASCII field specifies the pose position of the subject at any possible orientation within a circle. Its value shall be to a nearest degree.

The offset angle shall be measured from the full-face pose position and have a range of values from -180 degrees to +180 degrees. A positive angle is used to express the angular offset as the subject rotates from a full-face pose to their right (approaching a left profile). A negative angle is used to express the angular offset as the subject rotates from a full-face pose to their left (approaching a right profile). If the entry in the POS field is an "F", "L" , or "R", the contents of this field are ignored.

12.1.20 Field 10.022: Photo Description (PXS)

This optional ASCII field shall be used for the exchange of facial image data. When present, it shall describe special attributes of the captured facial image. Attributes associated with the facial image may be selected from Table 21 and entered in this field.

Facial image attribute	Attribute code
Subject Wearing Glasses	GLASSES
Subject Wearing Hat	HAT
Subject Wearing Scarf	SCARF
Physical Characteristics	PHYSICAL
Other Characteristics	OTHER

Table 20 Photo descriptors

Physical characteristics, such as "FRECKLES" may be entered as a subfield consisting of two information items. The first is "PHYSICAL" followed by the “US” separator, followed by the characteristic as listed in the Ninth (or current) Edition of the NCIC Code Manual, December, 2000. The "OTHER" category is used to enter unlisted or miscellaneous attributes of the facial image. This information shall be entered as a two-information item subfield. The first is "OTHER" followed by the “US” separator, followed by the unformatted text used to describe the attribute. Multiple attributes and subfields may be listed but must be separated by the “RS” character.
Note: The Subject facial description (SXS), field 26, is intended as a replacement for this PXS field. Table 21 entries are now duplicated and expanded upon in Table 23.

12.1.21 Field 10.023: Photo acquisition source (PAS)

This optional field shall specify the classification of the source of the image contained in this record. This field is mandatory if the SAP entry (Field 10.013) is "40" or greater. When included, this field shall contain an ASCII character code selected from Table 21 to describe the source of captured image data.

Acquisition source type attribute	Attribute code
Unspecified or unknown	UNSPECIFIED
Static photograph from an unknown source	UNKNOWN PHOTO
Static photograph from a digital still-image camera	DIGITAL CAMERA
Static photograph from a scanner	SCANNER
Single video frame from an unknown source	UNKNOWN VIDEO
Single video frame from an analogue video camera	ANALOGUE VIDEO
Single video frame from a digital video camera	DIGITAL VIDEO
Vendor Specific source	VENDOR

Table 21 Acquisition sources

The *"VENDOR"* category is used to enter unlisted or miscellaneous source attributes of the facial image. This information shall be entered as a two-information item subfield. The first is *"VENDOR"* followed by the *“US”* separator, followed by the unformatted text used to describe the attribute.

12.1.22 Field 10.024: Subject quality score (SQS)

This optional ASCII field shall specify quality score data for facial images stored in this record. Each subfield shall contain three information items separated by the "US" separator character. They identify a quality score and the algorithm used to create the quality score. This information is useful to enable the recipient of the quality score to differentiate between quality scores generated by different algorithms and adjust for any differences in processing or analysis as necessary.

1. The first information item shall be a quantitative expression of the predicted matching performance of the biometric sample. This item contains the ASCII representation of the integer image quality score between 0 and 100 assigned to the image data by a quality algorithm. Higher values indicate better quality. An entry of "255" shall indicate a failed attempt to calculate a quality score. An entry of "254" shall indicate that no attempt to calculate a quality score was made. The use of additional values to convey other information should be harmonized with ISO/IEC 19794 standards.

2. The second information item shall specify the ID of the vendor of the quality algorithm used to calculate the quality score. This 4-digit hex value is assigned by IBIA and expressed as four ASCII characters. The IBIA shall maintain the Vendor Registry of CBEFF Biometric Organizations that will map the value in this field to a registered organization.

3. The third information item shall specify a numeric product code assigned by the vendor of the quality algorithm, which may be registered with the IBIA, but it is not required to be registered. It indicates which of the vendor's algorithms was used in the calculation of the quality score. This field contains the ASCII representation of the integer product code and should be within the range 1 to 65535.

12.1.23 Field 10.025: Subject pose angles (SPA)

This optional ASCII field shall be present when Field 10.020 (POS) contains a *"D"* to indicate a set of determined 3D pose angles of the same subject. If the entry in the POS Field is an *"F", "L"*, or *"R",* the contents of this field are ignored. When present, this information shall be entered as three or six information items.

The first is the Yaw angle (rotation about the vertical 'y' axis) followed by the "*US*" separator, followed by the Pitch angle (rotation about 'x' horizontal axis), followed by the "*US*" separator, followed by the Roll angle (rotation about the 'z' axis). The fourth, fifth and sixth information items denote the uncertainty degrees for the Yaw, Pitch, and Roll angles respectively. If the second triple of angles is not present, then the uncertainty in the angles is not determined, but the additional three "US" separators shall still be included.

The first three items specify the pose of the subject estimated or measured at constrained possible orientations within a sphere. Each angle value shall be to the nearest integer degree.

If both field 10.021 and this field are present, the Yaw angle of this field shall supersede the offset angle contained in Field 10.021. Note that the Yaw angle of this field has the opposite sign of the offset angle contained in Field 10.021. Annex J contains, additional information, details, and examples of the subject pose angles.

12.1.24 Field 10.026: Subject facial description (SXS)

This optional ASCII field shall be used for the exchange of facial image data. This field is mandatory if the SAP entry (Field 10.013) is "40" or greater. When present, it shall describe the facial expression of the subject and other attributes associated with the subject's captured facial image. This field may have one or more subfields each containing a single information item. Attributes associated with the facial image may be selected from Table 23 and entered in this field. For "Physical Characteristic", enter a characteristic as listed in the Ninth (or current) Edition of the NCIC Code Manual, December, 2000. For the "Other Characteristic" enter unlisted or miscellaneous attributes as unformatted text used to describe the attribute. Multiple attributes may be listed but must be separated by the *"RS"* character.

Facial description attribute	Attribute code
Expression unspecified	UNKNOWN
Neutral (non-smiling) with both eyes open and mouth closed)	NEUTRAL
Smiling where the inside of the mouth and/or teeth is not exposed (closed jaw)	SMILE
Subject Having Mouth open	MOUTH OPEN
Having Teeth visible	TEETH VISIBLE
Raising eyebrows	RAISED BROWS
Frowning	FROWNING
Looking away from the camera	EYES AWAY
Squinting	SQUINTING
Subject Wearing Left Eye Patch	LEFT EYE PATCH
Subject Wearing Right Eye Patch	RIGTH EYE PATCH
Subject Wearing Clear Glasses	CLEAR GLASSES
Subject Wearing Dark or Visible Colored Glasses (medical)	DARK GLASSES
Head covering/hat	HAT
Wearing Scarf	SCARF
Having Moustache	MOUSTACHE
Having Beard	BEARD
Ear(s) obscured by hair	NO EAR
Blinking (either or both eyes closed)	BLINK
Having Distorting Medical Condition impacting Feature Point detection	DISTORTING CONDITION
Physical Characteristics	<From NCIC Code Manual>
Other Characteristics	<Unformatted Text>

Table 22 Subject facial description codes

12.1.25 Field 10.027: Subject eye color (SEC)

This optional ASCII field shall be used for the exchange of facial image data. This field is mandatory if the SAP entry (Field 10.013) is "40" or greater. When present, it shall describe the eye color of the subject as seen in the photograph. If unusual or unnatural such as may be the case when colored contact lenses are present and the "real" eye color cannot be ascertained, then the color should be labeled as "XXX". Eye color attributes and attribute codes are given by Table 23.

Eye color attribute	Attribute code
Black	BLK
Blue	BLU
Brown	BRO
Gray	GRY
Green	GRN
Hazel	HAZ
Maroon	MAR
Multicolored	MUL
Pink	PNK
Unknown	XXX

Table 23 Eye color codes

Note: This field is intended to replace the photo description field (PXS) and to enhance the content with additional descriptive information. As such, photo descriptors found in Table 20 also appear in Table 22.

12.1.26 Field 10.028: Subject hair color (SHC)

This optional ASCII field shall be used for the exchange of facial image data. This field is mandatory if the SAP entry (Field 10.013) is "40" or greater. When present, it shall contain an entry form Table 25 that describes the hair color of the subject as seen in the photograph. For unusual or unnatural colors not listed in the table, or the "real" color cannot be ascertained, the hair color should be labeled as “XXX”.

If the subject is completely bald, or has a completely shaved head, then the hair color shall be labeled as “BAL”. When the subject is predominantly bald, but hair color is discernable, then the appropriate hair color attribute code shall follow “BAL” (separated by the *“RS”* character).

Hair color attribute	Attribute code
Unspecified or unknown	XXX
Bald	BAL
Black	BLK
Blonde or Strawberry	BLN
Brown	BRO
Gray or Partially Gray	GRY
Red or Auburn	RED
Sandy	SDY
White	WHI
Blue	BLU
Green	GRN
Orange	ONG
Pink	PNK
Purple	PLE

Table 24 Hair color codes

12.1.27 Field 10.029: Facial feature points (FFP)

The optional ASCII field shall be used for the exchange of facial image data. When present, it shall describe special attributes of manually or automatically detected facial feature points of the captured facial image. This information shall be entered as a four-information item feature point block as described in Table 26. The first information item is feature point type. For this version of the standard the only allowable value is "1" which is followed by the "*US*" separator character. The second is feature point code, followed by the "*US*" separator character. The third is the *X* coordinate of a feature point, followed by the "*US*" separator character. The fourth and final item is the *Y* coordinate of a feature point in the facial image. Multiple facial points may be listed using these four information items. But each feature block must be separated by the "RS" separator character. The maximum number of feature points shall be 88, with the use of 84 MPEG4 feature points and 4 additional eye and nostril center feature points.

Item	Size	Value	Notes
Feature Point Type	1 character	1	Denotes a 2D Feature Point
Feature Point Code	3-5 characters	A, B in ASCII text A and B are described in xxxx	The maximum value of A is 12 and of B is 15
X coordinate	1-4 characters	Horizontal pixel count from upper left pixel	Count starts at 0
Y coordinate	1-4 characters	Vertical pixel count from upper left pixel	Count starts at 0

Table 25 Subject feature point field

Feature points shall be included in the record format if they have been accurately determined, thereby providing the option that that these parameters do not have to be re-determined when the image is processed for face recognition tasks.

Typically a computer algorithm will either accurately determine the position of the feature point or completely fail and provide either clearly erroneous or no landmark information. Therefore, a method for accurate determination is the use of computer-automated feature point determination followed by human verification and potential override of the computer determined feature points.

12.1.27.1 MPEG4 Feature points

The feature point code item shall specify the feature point that is stored in the feature point block. The codes for the feature points are taken from the MPEG4 standard and defined as MPEG4 feature points. Each feature point code is represented by a notation A.B using a major (A) and a minor (B) value. The encoding of the feature point code is given by the numeric ASCII representation of the value of A.B. The period is required, and the maximum size of this entry shall be 5 characters.
Figure 5 denotes the feature point codes associated with feature points as given by Annex C of ISO/IEC 14496-2. Each code is given by major value A and minor value B. For example, the code for the left corner of the left eye is given by major value 3 and minor value 7.

12.1.27.2 Eye and nostril centre Feature Points

The eye center feature points 12.1 (left) and 12.2 (right) are defined to be the horizontal and vertical midpoints of the eye corners (3.7, 3.11) and (3.8, 3.12) respectively. The left nostril center feature point 12.3 is defined to be the midpoint of the nose feature points (9.1, 9.15) in the horizontal direction and (9.3, 9.15) in the vertical direction. Similarly, the right nostril center feature point 12.4 is defined to be the midpoint of the nose feature points (9.2, 9.15) in the horizontal direction and (9.3, 9.15) in the vertical direction. Both the eyeye center and nostril center Feature points are shown in Figure 6 and values given in Table 26.

Center Feature Point	Midpoint of Feature Points		Feature Point code
Left Eye	3.7, 3.11		12.1
Right Eye	3.8, 3.12		12.2
Left Nostril	Horizontal	Vertical	12.3
	9.1, 9.15	9.3, 9.15	
Right Nostril	Horizontal	Vertical	12.4
	9.2, 9.15	9.3, 9.15	

Table 26 Eye and nostril center feature point codes

An example transaction for representing two feature points of eye centers is "10.029:1US12.2US120US130 RS1US12.1US240US129GS".

12.1.28 Field 10.030: Device monitoring mode (DMM)

This optional field provides information describing the level of human monitoring for the image capture device. This field will contain an entry from Table 27 to indicate the monitoring mode of the biometric sample capture device.

CONDITION	DESCRIPTION
CONTROLLED	Operator physically controls the subject to acquire biometric sample
ASSISTED	Person available to provide assistance to subject submitting the biometric
OBSERVED	Person present to observe operation of the device but provides no assistance
UNATTENDED	No one present to observe or provide assistance
UNKNOWN	No information is known

Table 27 Device monitoring modes

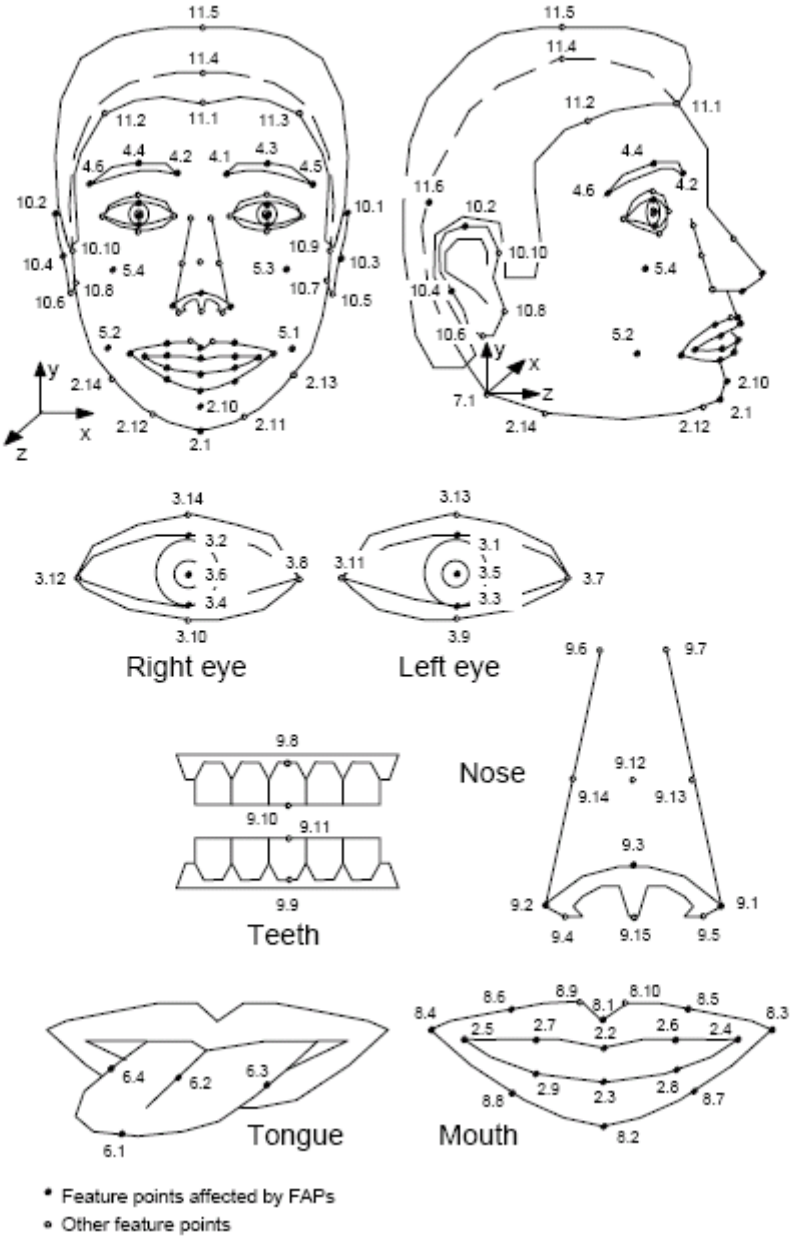

Figure 3 Feature point codes defined in ISO/IEC 14496-2

12.1.29 Field 10.031-.039: Reserved for Future Definition (RSV)

These fields are reserved for inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

12.1.30 Field 10.040: NCIC Designation Code (SMT)

This field is mandatory for a Type-10 record containing SMT image data. It is used to identify a general location of the captured scar, mark, or tattoo image. The contents of this field will be an entry chosen from Part 4 Section 13 of the Eighth (or current) Edition of the NCIC Code Manual, July 14, 1999 (see table 10.4b - 10.4e). The captured image can encompass an area

larger than that specified by a single NCIC body part code for the particular image type. This situation can be accommodated by listing multiple NCIC codes separated by the *"RS"* separator character. In this case the primary code is listed first.

For the "marks" category, the NCIC manual lists the common locations for needle track marks. The body location codes listed for scars shall be used for other body part locations or other types of marks not listed in the NCIC Code Manual.

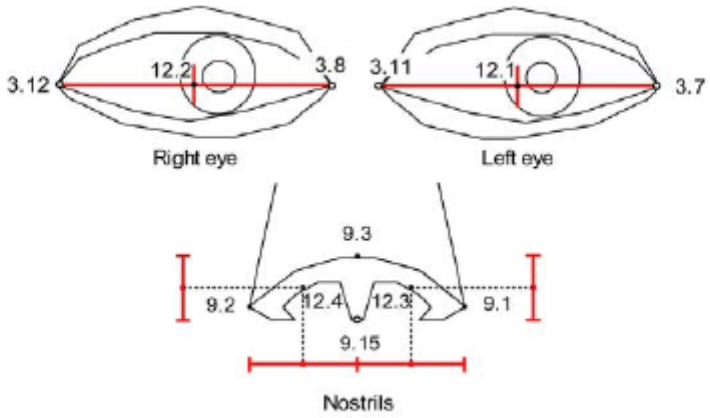

Figure 4 Eye and nostril center feature points

Item/Location	Code
Bald/Balding	BALD
Cleft chin	CLEFT CHIN
Dimple, Chin	DIMP CHIN
Dimples, left cheek (face)	DIMP L CHK
Dimples, right cheek (face)	DIMP R CHK
Freckles	FRECKLES
Hair implants	HAIR IMPL
Pierced abdomen	PRCD ABDMN
Pierced back	PRCD BACK
Pierced ear, one, nonspecific	PRCD EAR
Pierced ears	PRCD EARS
Pierced left ear	PRCD L EAR
Pierced right ear	PRCD R EAR
Pierced Eyebrow, nonspecific	PRCD EYE
Pierced Left Eyebrow	PRCD L EYE
Pierced Right Eyebrow	PRCD R EYE
Pierced genitalia	PRCD GNTLS
Pierced lip, nonspecific	PRCD LIP
Pierced lip, upper	PRCD ULIP
Pierced lip, lower	PRCD LLIP
Pierced nipple, nonspecific	PRCD NIPPL
Pierced nipple, left	PRCD L NIP
Pierced nipple, right	PRCD R NIP
Pierced nose	PRCD NOSE

Item/Location	Code
Pierced Tongue	PRCD TONGU
Stutters	STUTTERS
Transsexual (Miscellaneous Field should indicate what the individual was at birth and what they are at the time the record is entered in NCIC. [Example: Born male - had surgery and is now female.])	TRANSSXL
Transvestite	TRANSVST

Item/Location	Code	Item/Location	Code
Abdomen	SC ABDOM	Foot, nonspecific	SC FOOT
Ankle, nonspecific	SC ANKL	Foot, left	SC L FT
Ankle, left	SC L ANKL	Foot, right	SC R FT
Ankle, right	SC R ANKL	Forearm, nonspecific	SC F ARM
Arm, nonspecific	SC ARM	Forearm, left	SC LF ARM
Arm, left	SC L ARM	Forearm, right	SC RF ARM
Arm, right (Use the MIS Field to further describe location)	SC R ARM	Forehead	SC FHD
Arm, left upper	SC UL ARM	Groin area	SC GROIN
Arm, right upper	SC UR ARM	Hand, nonspecific	SC HAND
Back	SC BACK	Hand, left	SC L HND
Breast, nonspecific	SC BREAST	Hand, right	SC R HND
Breast, left	SC L BRST	Head, nonspecific (Use the MIS Field to further describe location)	SC HEAD
Breast, right	SC R BRST	Hip, nonspecific	SC HIP
Buttock, nonspecific	SC BUTTK	Hip, left	SC L HIP
Buttock, left	SC L BUTTK	Hip, right	SC R HIP
Buttock, right	SC R BUTTK	Knee, nonspecific	SC KNEE
Calf, nonspecific	SC CALF	Knee, left	SC L KNEE
Calf, left	SC L CALF	Knee, right	SC R KNEE
Calf, right	SC R CALF	Leg, nonspecific	SC LEG
Cheek (face), nonspecific	SC CHK	Leg, left, nonspecific	SC L LEG
Cheek (face), left	SC L CHK	Leg, right, nonspecific (Use the MIS Field to further describe location)	SC R LEG
Cheek (face), right	SC R CHK	Lip, nonspecific	SC LIP
Chest	SC CHEST	Lip, lower	SC LOW LIP
Chin	SC CHIN	Lip, upper	SC UP LIP
Ear, nonspecific	SC EAR	Neck	SC NECK
Ear, left	SC L EAR	Nose	SC NOSE
Ear, right	SC R EAR	Penis	SC PENIS
Elbow, nonspecific	SC ELBOW	Pockmarks	POCKMARKS
Elbow, left	SC L ELB	Shoulder, nonspecific	SC SHLD
Elbow, right	SC R ELB	Shoulder, left	SC L SHLD
Eyebrow, nonspecific	SC EYE	Shoulder, right	SC R SHLD
Eyebrow, left/left eye area	SC L EYE	Thigh, nonspecific	SC THGH
Eyebrow, right/right eye area	SC R EYE	Thigh, left	SC L THGH
Face, nonspecific (Use the MIS Field to further describe location)	SC FACE	Thigh, right	SC R THGH
Finger, nonspecific	SC FGR	Wrist, nonspecific	SC WRIST
Finger(s), left hand	SC L FGR	Wrist, left	SC L WRIST
Finger(s), right hand	SC R FGR	Wrist, right	SC R WRIST

Table 28 Scars (SC)

Item/Location	Code	Item/Location	Code
Arm, left	NM L ARM	Hand, left	NM L HND
Arm, right	NM R ARM	Hand, right	NM R HND
Buttock, left	NM L BUTTK	Leg, left	NM L LEG
Buttock, right	NM R BUTTK	Leg, right	NM R LEG
Finger(s), left hand	NM L FGR	Thigh, left	NM L THIGH
Finger(s), right hand	NM R FGR	Thigh, right	NM R THIGH
Foot, left	NM L FOOT	Wrist, left	NM L WRIST
Foot, right	NM R FOOT	Wrist, right	NM R WRIST

Table 29 Needle ("Track") Marks (NM)

Item/Location	Code	Item/Location	Code
Abdomen	TAT ABDOM	Forearm, nonspecific	TAT FARM
Ankle, nonspecific	TAT ANKL	Forearm, left	TAT LF ARM
Ankle, left	TAT L ANKL	Forearm, right	TAT RF ARM
Ankle, right	TAT R ANKL	Forehead	TAT FHD
Arm, nonspecific	TAT ARM	Full Body (Use only when the entire body - arms, legs, chest, and back are covered with tattoos.)	TAT FLBODY
Arm, left	TAT L ARM	Groin Area	TAT GROIN
Arm, right (Use the MIS Field to further describe location)	TAT R ARM	Hand, nonspecific	TAT HAND
Arm, left upper	TAT UL ARM	Hand, left	TAT L HND
Arm, right upper	TAT UR ARM	Hand, right	TAT R HND
Back	TAT BACK	Head, nonspecific (Use the MIS Field to further describe location)	TAT HEAD
Breast, nonspecific	TAT BREAST	Hip, nonspecific	TAT HIP
Breast, left	TAT L BRST	Hip, left	TAT L HIP
Breast, right	TAT R BRST	Hip, right	TAT R HIP
Buttocks, nonspecific	TAT BUTTK	Knee, nonspecific	TAT KNEE
Buttock, left	TAT L BUTK	Knee, left	TAT L KNEE
Buttock, right	TAT R BUTK	Knee, right	TAT R KNEE
Calf, nonspecific	TAT CALF	Leg, nonspecific	TAT LEG
Calf, left	TAT L CALF	Leg, left	TAT L LEG
Calf, right	TAT R CALF	Leg, right (Use the MIS Field to further describe location)	TAT R LEG
Cheek (face), nonspecific	TAT CHEEK	Lip, nonspecific	TAT LIP
Cheek (face), left	TAT L CHK	Lip, lower	TAT LW LIP
Cheek (face), right	TAT R CHK	Lip, upper	TAT UP LIP
Chest	TAT CHEST	Neck	TAT NECK
Chin	TAT CHIN	Nose	TAT NOSE
Ear, nonspecific	TAT EAR	Penis	TAT PENIS
Ear, left	TAT L EAR	Shoulder, nonspecific	TAT SHLD
Ear, right	TAT R EAR	Shoulder, left	TAT L SHLD
Elbow, nonspecific	TAT ELBOW	Shoulder, right	TAT R SHLD
Elbow, left	TAT LELBOW	Thigh, nonspecific	TAT THGH
Elbow, right	TAT RELBOW	Thigh, left	TAT L THGH

Item/Location	Code	Item/Location	Code
Face, nonspecific (Use the MIS Field to further describe location)	TAT FACE	Thigh, right	TAT R THGH
Finger, nonspecific	TAT FNGR	Wrist, nonspecific	TAT WRS
Finger(s), left hand	TAT L FGR	Wrist, left	TAT L WRS
Finger(s), right hand	TAT R FGR	Wrist, right	TAT R WRS
Foot, nonspecific	TAT FOOT		
Foot, left	TAT L FOOT		
Foot, right	TAT R FOOT		

Table 30 Tattoos (TAT)

Item/Location	Code	Item/Location	Code
Abdomen	RTAT ABDM	Forearm, nonspecific	RTAT FARM
Ankle, nonspecific	RTAT ANKL	Forearm, left	RTAT LFARM
Ankle, left	RTAT LANKL	Forearm, right	RTAT RFARM
Ankle, right	RTAT RANKL	Forehead	RTAT FHD
Arm, nonspecific	RTAT ARM	Full Body (Use only when the entire body - arms, legs, chest, and back are covered with tattoos.)	RTAT FLBOD
Arm, left	RTAT L ARM	Groin Area	RTAT GROIN
Arm, right (Use the MIS Field to further describe location)	RTAT R ARM	Hand, nonspecific	RTAT HAND
Arm, left upper	RTAT ULARM	Hand, left	RTAT L HND
Arm, right upper	RTAT URARM	Hand, right	RTAT R HND
Back	RTAT BACK	Head, nonspecific (Use the MIS Field to further describe location)	RTAT HEAD
Breast, nonspecific	RTAT BRST	Hip, nonspecific	RTAT HIP
Breast, left	RTAT LBRST	Hip, left	RTAT L HIP
Breast, right	RTAT RBRST	Hip, right	RTAT R HIP
Buttocks, nonspecific	RTAT BUTTK	Knee, nonspecific	RTAT KNEE
Buttock, left	RTAT LBUTK	Knee, left	RTAT LKNEE
Buttock, right	RTAT RBUTK	Knee, right	RTAT RKNEE
Calf, nonspecific	RTAT CALF	Leg, nonspecific	RTAT LEG
Calf, left	RTAT LCALF	Leg, left	RTAT L LEG
Calf, right	RTAT RCALF	Leg, right (Use the MIS Field to further describe location)	RTAT R LEG
Cheek (face), nonspecific	RTAT CHEEK	Lip, nonspecific	RTAT LIP
Cheek (face), left	RTAT L CHK	Lip, lower	RTAT LWLIP
Cheek (face), right	RTAT R CHK	Lip, upper	RTAT UPLIP
Chest	RTAT CHEST	Neck	RTAT NECK
Chin	RTAT CHIN	Nose	RTAT NOSE
Ear, nonspecific	RTAT EAR	Penis	RTAT PENIS
Ear, left	RTAT L EAR	Shoulder, nonspecific	RTAT SHLD
Ear, right	RTAT R EAR	Shoulder, left	RTAT LSHLD
Elbow, nonspecific	RTAT ELBOW	Shoulder, right	RTAT RSHLD
Elbow, left	RTAT L ELB	Thigh, nonspecific	RTAT THGH
Elbow, right	RTAT R ELB	Thigh, left	RTAT LTHGH
Face, nonspecific (Use the MIS Field to further describe location)	RTAT FACE	Thigh, right	RTAT RTHGH
Finger, nonspecific	RTAT FNGR	Wrist, nonspecific	RTAT WRS
Finger(s), left hand	RTAT L FGR	Wrist, left	RTAT LWRS
Finger(s), right hand	RTAT R FGR	Wrist, right	RTAT RWRS

Item/Location	Code	Item/Location	Code
Foot, nonspecific	RTAT FOOT		
Foot, left	RTAT LFOOT		
Foot, right	RTAT RFOOT		

Table 31 Removed Tattoos (RTAT)

12.1.19 Field 10.041: SMT Size (SMS)

This optional field shall contain the dimensions of the scar, mark or tattoo. It shall consists of two information items. The height shall be the first information item followed by the "*US*" separator character followed by the width. Each dimension shall be entered to the nearest centimeter.

12.1.20 Field 10.042: SMT Descriptors (SMD)

This optional field is used to describe the content of the SMT image. It shall consist of one or more subfields. Each subfield shall contain three or four information items that provide progressively detailed information describing the total image or a portion of the image.

The first information item of each subfield shall identify the source of the SMT. lt shall contain "*SCAR*" to indicate healed scar tissue that was the result an accident or medical procedure. An entry of "*MARK*" shall be used for the pattern resulting from needle or "*Track*" marks. For either case the second and third information items shall contain "*OTHER*" and "*MISC*" and the fourth information item shall contain a textual description or other information concerning the scar or mark pattern.

For deliberately applied or drawn images, the first information item will contain "*TATTOO*" to indicate a common tattoo or indelible image resulting from the pricking of the skin with a coloring matter; "*CHEMICAL*" if the image was created by the use of chemicals to burn the image into the skin; "'*BRANDED*" if the image was burned into the skin using a branding iron or other form of heat; or "*CUT*" if the image was caused by incision of the skin.

The second information item shall be the general class code of tattoo chosen from Table 10.5. For each general class of tattoo, there are several defined subclasses. The third information item of the subfield shall be the appropriate subclass code selected from Tables 10.6a - 10.6h which lists the various subclasses of tattoos for each of the general classes.

The final and optional information item in this subfield shall be an ASCII text string that provides additional qualifiers to describe the image or portion of the image. For example, to fully describe a tattoo, there may be a class description of "*ANIMAL*", with a subclass description of "*DOG*", and qualified by "*golden retriever with an overbite*". The "*US*" separator character will be used between information items.

An SMT image consisting of several parts or sub-images shall use multiple subfields, separated by the "*RS*" separator, to fully describe the various parts or features found in the total image. The first subfield shall describe the most predominant feature or sub-image contained in the SMT image. Subsequent subfields shall describe additional portions of the image that are not part of the main or central focal point of the image. For example, a tattoo consisting of a man with a

snake on the arm being followed by a dog may contain three subfields - one describing the man, a second describing the snake, and a third describing the dog.

Class description	Class code
Human Forms and Features	HUMAN
Animals and Animal Features	ANIMAL
Plants	PLANT
Flags	FLAG
Objects	OBJECT
Abstractions	ABSTRACT
Insignias & Symbols	SYMBOL
Other Images	OTHER

Table 32 Tattoo classes

Subclass	Subclass code
Male Face	MFACE
Female Face	FFACE
Abstract Face	ABFACE
Male Body	MBODY
Female Body	FBODY
Abstract Body	ABBODY
Roles (Knight, Witch, man, etc.)	ROLES
Sports Figures (Football Player, Skier, etc.)	SPORT
Male Body Parts	MBPART
Female Body Parts	FBPART
Abstract Body Parts	ABBPART
Skulls	SKULL
Miscellaneous Human Forms	MHUMAN

Table 33 Human tattoo subclasses

Subclass	Subclass code
Cats & Cat Heads	CAT
Dogs & Dog Heads	DOG
Other Domestic Animals	DOMESTIC
Vicious Animals (Lions, Tigers, Wolves, etc.)	VICIOUS
Horses (Donkeys, Mules, etc.)	HORSE
Other Wild Animals	WILD
Snakes	SNAKE
Dragons	DRAGON
Birds (Cardinal, Hawk, etc.)	BIRD
Spiders, Bugs, and Insects	INSECT
Abstract Animals	ABSTRACT
Animal Parts	PARTS
Miscellaneous Animal Forms	MANIMAL

Table 34 Animal tattoo subclasses

Subclass	Subclass code
Narcotics	NARCOTICS
Red Flowers	REDFL
Blue Flowers	BLUEFL
Yellow Flowers	YELFL
Drawings of Flowers	DRAW
Rose	ROSE
Tulip	TULIP
Lily	LILY
Miscellaneous Plants, Flowers, Vegetables	MPLANT

Table 35 Plant tattoo subclasses

Subclass	Subclass code
American Flag	USA
State Flag	STATE
Nazi Flag	NAZI
Confederate Flag	CONFED
British Flag	BRIT
Miscellaneous Flags	MFLAG

Table 36 Flags tattoo subclasses

Subclass	Subclass code
Fire	FIRE
Weapons (Guns, Arrows, etc.)	WEAP
Airplanes	PLANE
Boats, Ships, and Other Vessels	VESSEL
Trains	TRAIN
Cars, Trucks, and Vehicles	VEHICLE
Mythical (Unicorns, etc.)	MYTH
Sporting Objects (Football, Ski, Hurdles, etc.)	SPORT
Water & Nature Scenes (Rivers, Sky, Trees, etc.)	NATURE
Miscellaneous Objects	MOBJECTS

Table 37 Object tattoo subclasses

Subclass	Subclass code
Figure(s)	FIGURE
Sleeve	SLEEVE
Bracelet	BRACE
Anklet	ANKLET
Necklace	NECKLC
Shirt	SHIRT
Body Band	BODBND
Head Band	HEDBND
Miscellaneous Abstract	MABSTRACT

Table 38 Abstract tattoo subclasses

Subclass	Subclass code
National Symbols	NATION
Political Symbols	POLITIC
Military Symbols	MILITARY
Fraternal Symbols	FRATERNAL
Professional Symbols	PROFESS
Gang Symbols	GANG
Miscellaneous Symbols	MSYMBOLS

Table 39 Symbols tattoo subclasses

Subclass	Subclass code
Wording (Mom, Dad, Mary, etc.)	WORDING
Freeform Drawings	FREEFRM
Miscellaneous Images	MISC

Table 40 Other tattoo subclasses

12.1.21 Field 10.043: Color (COL)

This optional field shall contain one subfield corresponding to each subfield contained in Field 10.042. Each subfield shall contain one or more information items that list the color(s) of the tattoo or part of the tattoo. For each subfield, the first information item in the subfield shall be the predominant color chosen from Table 10.7. Additional colors for the sub-field shall be entered as information items in the subfield separated by the "*US*" separator character.

Table 10.7 - Other tattoo subclasses

Color Description	Color Code
Black	BLACK
Brown	BROWN
Gray	GRAY
Blue	BLUE
Green	GREEN
Orange	ORANGE
Purple	PURPLE
Red	RED
Yellow	YELLOW
White	WHITE
Multi-colored	MULTI
Outlined	OUTLINE

12.1.22 Field 10.044-199: Reserved for Future Definition (RSV)

These fields are reserved for inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

12.1.23 Field 10.200-998: User Defined Fields (UDF)

These fields are user-definable fields. Their size and content shall be defined by the user and be in accordance with the receiving agency. If present they shall contain ASCII textual information.

12.1.24 Field 10.999: Image Data (DAT)

This field shall contain all of the grayscale or color data from a face, scar, mark, tattoo, or other image. It shall always be assigned field number 999 and must be the last physical field in the record. For example, "10.999:" is followed by image data in a binary representation.

Each pixel of uncompressed grayscale data shall be quantized to eight bits (256 gray levels) contained in a single byte. Uncompressed color image data shall be expressed as 24 bit RGB pixels. The first byte shall contain the eight bits for the red component of the pixel, the second byte shall contain the eight bits for the green component of the pixel, and the third byte shall contain the last eight bits for the blue component of the pixel. If compression is used, the pixel data shall be compressed in accordance with the compression technique specified in the GCA field. If the JPEG algorithm is to be used to compress the data, this field shall be encoded using the JFIF format specification.

12.2 End of Type-10 Logical Record

For the sake of consistency, immediately following the last byte of data from field 10.999 an "*FS*" separator shall be used to separate it from the next logical record. This separator must be included in the length field of the Type-10 record.

12.3 Additional Facial & SMT Image Records

Additional Type-10 records may be included in the file. For each additional facial or SMT image, a complete Type-10 logical record together with the "*FS*" separator is required.

13 Type-13 variable-resolution latent image record

The Type-13 tagged-field logical record shall contain image data acquired from latent images. These images are intended to be transmitted to agencies that will automatically extract or provide human intervention and processing to extract the desired feature information from the images.

Information regarding the scanning resolution used, the image size, and other parameters required to process the image, are recorded as tagged-fields within the record.

Ident	Cond. code	Field Number	Field Name	Char type	Field size per occurrence		Occur count		Max byte count
					min.	max.	min	max	
LEN	M	13.001	LOGICAL RECORD LENGTH	N	4	8	1	1	15
IDC	M	13.002	IMAGE DESIGNATION CHARACTER	N	2	5	1	1	12
IMP	M	13.003	IMPRESSION TYPE	A	2	2	1	1	9
SRC	M	13.004	SOURCE AGENCY / ORI	AN	6	35	1	1	42
LCD	M	13.005	LATENT CAPTURE DATE	N	9	9	1	1	16
HLL	M	13.006	HORIZONTAL LINE LENGTH	N	4	5	1	1	12
VLL	M	13.007	VERTICAL LINE LENGTH	N	4	5	1	1	12
SLC	M	13.008	SCALE UNITS	N	2	2	1	1	9
HPS	M	13.009	HORIZONTAL PIXEL SCALE	N	2	5	1	1	12
VPS	M	13.010	VERTICAL PIXEL SCALE	N	2	5	1	1	12
CGA	M	13.011	COMPRESSION ALGORITHM	A	5	7	1	1	14
BPX	M	13.012	BITS PER PIXEL	N	2	3	1	1	10
FGP	M	13.013	FINGER POSITION	N	2	3	1	6	25
SPD	O	13.014	SEARCH POSITION DESCRIPTORS	A/N	6	7	0	9	82
PPC	O	13.015	POINT POSITION COORDINATES	N	15	28	0	12	343
SHPS	O	13.016	SCANNED HORIZONTAL PIXEL SCALE	N	2	5	0	1	12
SVPS	O	13.017	SCANNED VERTICAL PIXEL SCALE	N	2	5	0	1	12
RSV	-	13.018 13.019	RESERVED FOR FUTURE DEFINITION	--	--	--	--	--	--
COM	O	13.020	COMMENT	A	2	128	0	1	135
RSV		13.021 13.023	RESERVED FOR FUTURE DEFINITION	--	--	--	--	--	--
LQM	-	13.024	LATENT QUILITY METRIC	N	12	38	0	4	156
RSV	-	13.025 13.199		--	--	--	--	--	--
UDF	O	13.200 13.998	USER-DEFINED FIELDS	--	--	--	--	--	--
DAT	M	13.999	IMAGE DATA	B	2	--	1	1	--

Table 41 Variable-resolution latent record layout

Key for character type: N = Numeric; A = Alphabetic; AN = Alphanumeric; B = Binary

13.1 Fields for the Type-13 logical record

The following paragraphs describe the data contained in each of the fields for the Type-13 logical record.

Within a Type-13 logical record, entries shall be provided in numbered fields. It is required that the first two fields of the record are ordered, and the field containing the image data shall be the last physical field in the record. For each field of the Type-13 record, Table 11.1 lists the "condition code" as being mandatory "M" or optional "O", the field number, the field name, character type, field size, and occurrence limits. Based on a three digit field number, the maximum byte count size for the field is given in the last column. As more digits are used for the field number, the maximum byte count will also increase. The two entries in the "field size per occurrence" include all character separators used in the field. The "maximum

byte count" includes the field number, the information, and all the character separators including the "GS" character.

13.1.1 Field 13.001: Logical record length (LEN)

This mandatory ASCII field shall contain the total count of the number of bytes in the Type-13 logical record. Field 13.001 shall specify the length of the record including every character of every field contained in the record and the information separators.

13.1.2 Field 13.002: Image designation character (IDC)

This mandatory ASCII field shall be used to identify the latent image data contained in the record. This IDC shall match the IDC found in the file content (CNT) field of the Type-1 record.

13.1.3 Field 13.003: Impression type (IMP)

This mandatory one- or two-byte ASCII field shall indicate the manner by which the latent image information was obtained. The appropriate latent code choice selected from Table 4.1 (finger) or Table 13.2 (palm) shall be entered in this field.

13.1.4 Field 13.004: Source agency / ORI (SRC)

This mandatory ASCII field shall contain the identification of the administration or organization that originally captured the facial image contained in the record. Normally, the Originating Agency Identifier (ORI) of the agency that captured the image will be contained in this field. It consists of two information items in the following format:

CC/*agency*

The first information item contains the Interpol Country Code, two alpha-numeric characters long. The second item, *agency*, is a free text identification of the agency, up to a maximum of 32 alpha-numeric characters.

13.1.5 Field 13.005: Latent capture date (LCD)

This mandatory ASCII field shall contain the date that the latent image contained in the record was captured. The date shall appear as eight digits in the format CCYYMMDD. The CCYY characters shall represent the year the image was captured; the MM characters shall be the tens and units values of the month; and the DD characters shall be the tens and units values of the day in the month. For example, 20000229 represents February 29, 2000. The complete date must be a legitimate date.

13.1.6 Field 13.006: Horizontal line length (HLL)

This mandatory ASCII field shall contain the number of pixels contained on a single horizontal line of the transmitted image.

13.1.7 Field 13.007: Vertical line length (VLL)

This mandatory ASCII field shall contain the number of horizontal lines contained in the transmitted image.

13.1.8 Field 13.008: Scale units (SLC)

This mandatory ASCII field shall specify the units used to describe the image sampling frequency (pixel density). A "1" in this field indicates pixels per inch, or a "2" indicates pixels per centimeter. A "0" in this field indicates no scale is given. For this case, the quotient of HPS/VPS gives the pixel aspect ratio.

13.1.9 Field 13.009: Horizontal pixel scale (HPS)

This mandatory ASCII field shall specify the integer pixel density used in the horizontal direction providing the SLC contains a "1" or a "2". Other-wise, it indicates the horizontal component of the pixel aspect ratio.

13.1.10 Field 13.010: Vertical pixel scale (VPS)

This mandatory ASCII field shall specify the integer pixel density used in the vertical direction pro-viding the SLC contains a "1" or a "2". Otherwise, it indicates the vertical component of the pixel aspect ratio.

13.1.11 Field 13.011: Compression algorithm (CGA)

This mandatory ASCII field shall specify the algorithm used to compress the transmitted grayscale images. An entry of *"NONE"* in this field indicates that the data contained in this record is uncompressed. For those images that are to be lossless compressed, this field shall contain the code from Table 1 to indicate the compression method used for the latent fingerprint images. See Section 5.6.1. for additional information on the usage of JPEG 2000 for the compression of fingerprint images. The domain registrar shall maintain a registry of acceptable compression techniques and corresponding codes that may be used as they become available.

13.1.12 Field 13.012: Bits per pixel (BPX)

This mandatory ASCII field shall contain the number of bits used to represent a pixel. This field shall contain an entry of "8" for normal grayscale values of "0" to "255". Any entry in this field greater than "8" shall represent a grayscale pixel with increased precision.

13.1.13 Field 13.013: Finger / palm position (FGP)

This mandatory tagged field shall contain one or more possible finger or palm positions that may match the latent image. The decimal code number corresponding to the known or most probable finger position shall be taken from Table 12 or the most probable palm position from Table 35 and entered as a one- or two-character ASCII subfield. Additional finger and/or palm positions may be referenced by entering the alternate position codes as subfields separated by the *"RS"* separator character. The code "0", for "Unknown Finger", shall be used to reference every finger position from one through ten. The code "20", for "Unknown Palm", shall be used to reference every listed palmprint position. Code "19" shall be used to reference one or more parts of an EJI or tip.

13.1.14 Field 13.014: Search Position Descriptors (SPD)

This ASCII field shall be present if and only if the finger position code "19" appears in Field 13.013. It is used to narrow the search of the latent image in this record against a database. This field shall consist of two mandatory information items. The first is the probable decimal finger position code (0-10) taken from Table 12. A "0" indicates that all the fingers of a possible candidate should be searched. The second information item is the code taken from Table 32 to indicate the portion of the EJI or tip image in the database to search. Latent images of full-length fingers use codes FV1 through FV4 as defined in Table 32. Figure 7 is an illustration of the Entire Joint Image for a middle finger with each of the full finger views and constituent parts identified. The EJI code is used for the case where all four finger images are to be considered. For the case where the latent is to be compared to proximal, distal, or medial segments of a finger, this information item will contain the appropriate finger segment character. Multiple portions of the EJI can be listed and separated by the "RS" separator character.

Type of Image	Image Code
Entire Joint Image	EJI
Rolled Tip	TIP
Full Finger Rolled Image	FV1

Type of Image	Image Code
Full Finger Plain Image – left side	FV2
Full Finger Plain Image – center	FV3
Full Finger Plain Image – right side	FV4
Proximal, Distal or Medial Segments	PRX, DST, MED

Table 42 EJI and tip codes

NOTE: Fields 13.014 and 13.015 are included to make the standard flexible enough to accommodate many different scenarios and applications. These two fields facilitate searching of latents formatted within Type-13 records against Type-14 records contained in the various database files. The search of a database by a latent can be narrowed with the use of additional information such as finger position, finger segment, or full finger view. It is unlikely that an entire EJI will ever be left at the scene of a crime. But a latent can be searched against the EJIs in an image or features file based on a specific finger segment or full finger view. This can be accomplished for a portion of the latent described by the X and Y coordinates.

13.1.15 Field 13.015: Print Position Coordinates (PPC)

If finger position code “19” appears in field 13.013, this field contains offsets to the locations for the bounding box of the EJI, each of the full finger views, or segments within the EJI. When used, this field shall consist of six (6) mandatory information items to describe the type or portion of the latent image contained in this record and its location within an entire joint image. The first information item is the number of the full finger view with values of "FV1" through "FV4". Values of “FV1” to “FV4” specify the bounding coordinates for each full finger view. The second information item is used to identify the location of a segment within a full finger view. It will contain the not applicable code “NA” if the image portion refers to a full finger view or to the entire joint image locations. It shall contain “PRX”, “DST”, “MED” for a proximal, distal, or medial segment. The next four information items are the horizontal and vertical offsets relative to the origin positioned in the upper left corner of the image. The horizontal offsets (X) are the pixel counts to the right, and the vertical offsets (Y) are the pixel counts down. The location of the image portion is defined by the sequence of X coordinates (LEFT, RIGHT) and the Y coordinates (TOP, BOTTOM), of its bounding box. For the case of a fingertip, the first information item shall be “TIP”, and the second information item shall be “NA”. The next four information items are the horizontal and vertical offsets as defined above. The six information items within the field are separated by five “US” separators. This information will describe either the location of the entire joint image, one full finger view, or segment. Individual full finger or segment definitions may be repeated as subfields separated by the “RS” separator.

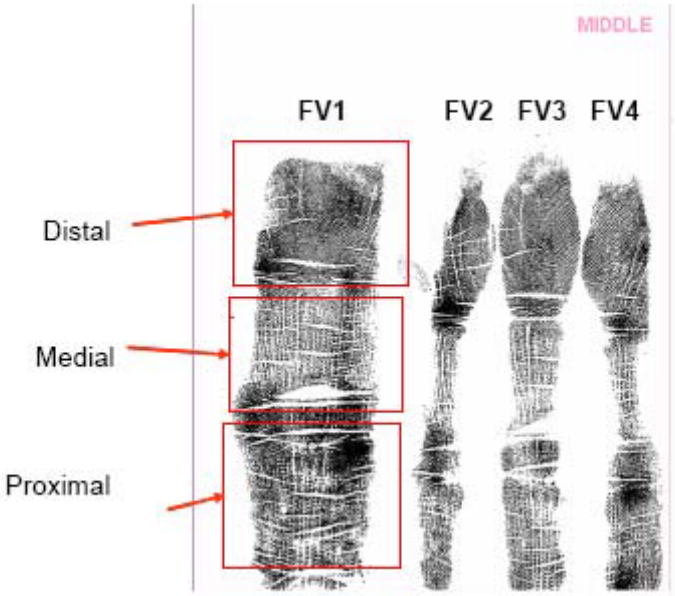

Figure 5 Entire joint image

13.1.16 Field 13.016: Scanned horizontal pixel scale (SHPS)

This optional ASCII field shall specify the horizontal pixel density used for the scanning of the original impression providing the SLC field contains a "1" or a "2". Otherwise, it indicates the horizontal component of the pixel aspect ratio.

13.1.17 Field 13.017: Scanned vertical pixel scale (SVPS)

This optional ASCII field shall specify the vertical pixel density used for the scanning of the original impression providing the SLC field contains a "1" or a "2". Otherwise, it indicates the vertical component of the pixel aspect ratio.

13.1.18 Field 13.018-019: Reserved for future definition (RSV)

These fields are reserved for inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

13.1.19 Field 13.020: Comment (COM)

This optional field may be used to insert comments or other ASCII text information with the latent image data.

13.1.20 Field 13.021-023: Reserved for future definition (RSV)

These fields are reserved for definition and inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

13.1.21 Field 13.024: Latent quality metric (LQM)

This optional ASCII field is used to specify one or more different metrics of latent image quality score data for the image stored in this record. The meaning attributed to this metric must be defined and interpreted by the producer of the scoring algorithm or by the person or system used to assign the metric to the latent image. The metric may be a predictor of AFIS matcher accuracy performance or a different metric to indicate a value associated with the quality of the latent image for a particular function.

This field may contain one or more subfields, each consisting of four information items separated by the "US" separator character. The first information item is the code as chosen from Table 12 or Table 35.

The other three items identify a quality score and the algorithm used to create the quality score. This information is useful to enable the recipient of the quality score to differentiate between quality scores generated by different algorithms and adjust for any differences in processing or analysis as necessary.

- ∉ The second information item shall be a quantitative expression of the predicted matching performance of the biometric sample. This item contains the ASCII representation of the integer image quality score between 0 and 100 assigned to the image data by a quality algorithm. Higher values indicate better quality. An entry of “255” shall indicate a failed attempt to calculate a quality score. An entry of “254” shall indicate that no attempt to calculate a quality score was made. The use of additional values to convey other information should be harmonized with ISO/IEC 19794 standards.
- ∉ The third information item shall specify the ID of the vendor of the quality algorithm used to calculate the quality score. This 4-digit hex value is assigned by IBIA and expressed as four ASCII characters. The IBIA shall maintain the Vendor Registry of CBEFF Biometric Organizations that will map the value in this field to a registered organization.
- ∉ The fourth information item shall specify a numeric product code assigned by the vendor of the quality algorithm, which may be registered with the IBIA, but registration is not required. It indicates which of the vendor’s algorithms was used in the calculation of the quality score. This field contains the ASCII representation of the integer product code and should be within the range 1 to 65535.

This subfield is repeated for each latent image and quality algorithm used, separated by the “RS” character.

13.1.22 Field 13.025-199: Reserved for future definition (RSV)

These fields are reserved for definition and inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

13.1.23 Fields 13.200-998: User-defined fields (UDF)

These fields are user-definable fields. Their size and content shall be defined by the user and be in accordance with the receiving agency. If present they shall contain ASCII textual information.

13.1.24 Field 13.999: Image data (DAT)

This field shall contain all of data from a captured latent image. It shall always be assigned field number 999 and must be the last physical field in the record. For example, "13.999:" is followed by image data in a binary representation.

Each pixel of uncompressed grayscale data shall normally be quantized to eight bits (256 gray levels) contained in a single byte. If the entry in BPX Field 13.012 is greater or less than "8", the number of bytes required to contain a pixel will be different. If compression is used, the pixel data shall be compressed in accordance with the compression technique specified in the GCA field.

13.2 End of Type-13 variable-resolution latent image record

For the sake of consistency, immediately following the last byte of data from field 13.999 an "FS" separator shall be used to separate it from the next logical record. This separator must be included in the length field of the Type-13 record.

13.3 Additional variable-resolution latent image records

Additional Type-13 records may be included in the file. For each additional latent image, a complete Type-13 logical record together with the "FS" separator is required.

14 Type-14 variable-resolution tenprint image record

The Type-14 tagged-field logical record shall contain and be used to exchange tenprint fingerprint image data. Rolled and plain fingerprint impressions shall be acquired from a tenprint card or from a live-scan device. Captured images are intended to be transmitted to agencies that will automatically extract the desired feature information from the images for matching purposes.

Textual information regarding the scanning resolution used, the image size and other parameters or comments required to process the image are recorded as tagged-fields within the record.

14.1 Fields for the Type-14 logical record

The following paragraphs describe the data contained in each of the fields for the Type-14 logical record.

Within a Type-14 logical record, entries shall be provided in numbered fields. It is required that the first two fields of the record are ordered, and the field containing the image data shall be the last physical field in the record. For each field of the Type-14 record, Table 12.1 lists the "condition code" as being mandatory "M" or optional "O", the field number, the field name, character type, field size, and occurrence limits. Based on a three digit field number, the maximum byte count size for the field is given in the last column. As more digits are used for the field number, the maximum byte count will also increase. The two entries in the "field size per occurrence" include all character separators used in the field. The "maximum byte count" includes the field number, the information, and all the character separators including the "GS" character.

Ident	Cond. code	Field Number	Field Name	Char type	Field size per occurrence		Occur count		Max byte count
					min.	max.	min	max	
LEN	M	14.001	LOGICAL RECORD LENGTH	N	4	8	1	1	15
IDC	M	14.002	IMAGE DESIGNATION CHARACTER	N	2	5	1	1	12
IMP	M	14.003	IMPRESSION TYPE	A	2	2	1	1	9
SRC	M	14.004	SOURCE AGENCY / ORI	AN	6	35	1	1	42
FCD	M	14.005	TENPRINT CAPTURE DATE	N	9	9	1	1	16
HLL	M	14.006	HORIZONTAL LINE LENGTH	N	4	5	1	1	12
VLL	M	14.007	VERTICAL LINE LENGTH	N	4	5	1	1	12
SLC	M	14.008	SCALE UNITS	N	2	2	1	1	9
HPS	M	14.009	HORIZONTAL PIXEL SCALE	N	2	5	1	1	12
VPS	M	14.010	VERTICAL PIXEL SCALE	N	2	5	1	1	12
CGA	M	14.011	COMPRESSION ALGORITHM	A	5	7	1	1	14
BPX	M	14.012	BITS PER PIXEL	N	2	3	1	1	10
FGP	M	14.013	FINGER POSITION	N	2	3	1	6	25
PPD	O	14.014	PRINT POSITION DESCRIPTORS	A/N	6	7	0	1	14
PPC	O	14.015	PRINT POSITION COORDINATES	A/N	15	28	0	12	343
SHPS	O	14.016	SCANNED HORIZONTAL PIXEL SCALE	N	2	5	0	1	12
SVPS	O	14.017	SCANNED VERTICAL PIXEL SCALE	N	2	5	0	1	12
AMP	O	14.018	AMPUTATED OR BANDAGED	A	5	6	0	4	31

Ident	Cond. code	Field Number	Field Name	Char type	Field size per occurrence		Occur count		Max byte count
					min.	max.	min	max	
RSV		14.019 14.019	RESERVED FOR FUTURE DEFINITION	--	--	--	--	--	--
COM	O	14.020	COMMENT	A	2	1 28	0	1	128
SEG		14.021	FINGERPRINT SEGMENTATION POSITION(S)	N	10	23	0	*	*
NQM		14.022	NIST QUALITY METRIC	N	4	7	0	4	35
SQM		14.023	SEGMENTATION QUALITY METRIC	N	16	76	0	*	*
FQM		14.024	FINGERPRINT QUALITY METRIC	N	16	76	0	*	*
ASEG		14.025	ALTERNATE FINGER SEGMENT POSITION(S)	N	16	--	0	4	--
RSV		14.026 14.029	RESERVED FOR FUTUTRE DEFINITION	--	--	--	--	--	--
DMM		14.030	DEVICE MONITORING MODE	A	8	11	0	1	18
RSV		14.030 14.199	RESERVED FOR FUTURE DEFINITION	--	--	--	--	--	--
UDF	O	14.200 14.998	USER-DEFINED FIELDS	--	--	--	--	--	--
DAT	M	14.999	IMAGE DATA	B	2	--	1	1	--

Table 43 Variable-resolution fingerprint record layout

Key for character type: N = Numeric; A = Alphabetic; AN = Alphanumeric; B = Binary

14.1.1 Field 14.001: Logical record length (LEN)

This mandatory ASCII field shall contain the total count of the number of bytes in the Type-14 logical record. Field 14.001 shall specify the length of the record including every character of every field contained in the record and the information separators.

14.1.2 Field 14.002: Image designation character (IDC)

This mandatory ASCII field shall be used to identify the tenprint fingerprint image contained in the record. This IDC shall match the IDC found in the file content (CNT) field of the Type-1 record.

14.1.3 Field 14.003: Impression type (IMP)

This mandatory one-byte ASCII field shall indicate the manner by which the tenprint image information was obtained. The appropriate code selected from Table 4.1 shall be entered in this field.

14.1.4 Field 14.004: Source agency / ORI (SRC)

This mandatory ASCII field shall contain the identification of the administration or organization that originally captured the facial image contained in the record. Normally, the Originating Agency Identifier (ORI) of the agency that captured the image will be contained in this field. It consists of two information items in the following format:

CC/*agency*

The first information item contains the Interpol Country Code, two alpha-numeric characters long. The second item, *agency*, is a free text identification of the agency, up to a maximum of 32 alpha-numeric characters.

14.1.5 Field 14.005: Fingerprint capture date (FCD)

This mandatory ASCII field (formerly named “Tenprint Capture Date” (TCD)) shall contain the date that the fingerprint image contained in the record was captured. The date shall appear as eight digits in the format *YYYYMMDD*. The *YYYY* characters shall represent the year the image was captured; the *MM* characters shall be the tens and units values of the month; and the *DD* characters shall be the tens and units values of the day in the month. For example, 20040229 represents February 29, 2004. The complete date must be a legitimate date.

14.1.6 Field 14.006: Horizontal line length (HLL)

This mandatory ASCII field shall contain the number of pixels contained on a single horizontal line of the transmitted image.

14.1.7 Field 14.007: Vertical line length (VLL)

This mandatory ASCII field shall contain the number of horizontal lines contained in the transmitted image.

14.1.8 Field 14.008: Scale units (SLC)

This mandatory ASCII field shall specify the units used to describe the image sampling frequency (pixel density). A "1" in this field indicates pixels per inch, or a "2" indicates pixels per centimeter. A "0" in this field indicates no scale is given. For this case, the quotient of HPS/VPS gives the pixel aspect ratio.

14.1.9 Field 14.009: Horizontal pixel scale (HPS)

This mandatory ASCII field shall specify the integer pixel density used in the horizontal direction providing the SLC contains a "1" or a "2". Other-wise, it indicates the horizontal component of the pixel aspect ratio.

14.1.10 Field 14.010: Vertical pixel scale (VPS)

This mandatory ASCII field shall specify the integer pixel density used in the vertical direction pro-viding the SLC contains a "1" or a "2". Otherwise, it indicates the vertical component of the pixel aspect ratio.

14.1.11 Field 14.011: Compression algorithm (CGA)

This mandatory ASCII field shall specify the algorithm used to compress the transmitted grayscale images. An entry of "NONE" in this field indicates that the data contained in this record is uncompressed. For those images that are to be compressed, this field shall contain the code from Table 1 to indicate the compression method used for this record type. The preferred methods for the compression of fingerprint images are WSQ for those images scanned or transmitted at 500 ppi or JPEG 2000 for those images scanned and transmitted at 1000 ppi. The domain registrar maintains a registry of acceptable compression techniques and corresponding codes that may be used as they become available.

14.1.12 Field 14.012: Bits per pixel (BPX)

This mandatory ASCII field shall contain the number of bits used to represent a pixel. This field shall contain an entry of “8” for normal grayscale values of “0” to “255”. Any entry in this field greater than or less than “8” shall represent a grayscale pixel with increased or decreased precision respectively.

14.1.13 Field 14.013: Finger position (FGP)

This mandatory tagged field shall contain the finger position that matches the tenprint image. The decimal code number corresponding to the known or most probable finger position shall be taken from Table 12 and entered as a one- or two-character ASCII subfield. Table 12 also lists the maximum image dimensions that can be transmitted for each of the sixteen possible finger positions. Additional finger positions may be referenced in the transaction by entering the alternate finger positions as subfields separated by the *“RS”* separator character. The code "0", for "Unknown Finger", shall be used to reference every finger position from one through ten. Code "19" shall be used to reference one or more parts of an EJI or tip.

14.1.14 Field 14.014: Print Position Descriptors (PPD)

This ASCII field shall be present if and only if the finger position code "19" appears in Field 14.014. This field shall consist of two mandatory information items. The first is the probable decimal finger position code (0-10) taken from Table 12. The second information item is the code taken from Table 32 to indicate the portion of the EJI or tip image that is stored as a single image in the database. There may be up to 17 such images for a single finger. Images of full-length fingers use codes FV1 through FV4 as defined in Table 32. Figure 7 is an illustration of the Entire Joint Image for a middle finger with each of the full finger views and constituent parts identified.

14.1.15 Field 14.015: Print Position Coordinates (PPC)

If finger position code “19” appears in field 14.013, this field contains offsets to the locations for the bounding box of the EJI, each of the full finger views, or segments within the EJI. When used, this field shall consist of six (6) mandatory information items to describe the type or portion of the image and its location within an entire joint image. The first information item is

the number of the full finger view with values of "FV1" through "FV4". Values of “FV1” to “FV4” specify the bounding coordinates for each full finger view. The second information item is used to identify the location of a segment within a full finger view. It will contain the not applicable code “NA” if the image portion refers to a full finger view or to the entire joint image locations. It shall contain “PRX”, “DST”, “MED” for a proximal, distal, or medial segment. The next four information items are the horizontal and vertical offsets relative to the origin positioned in the upper left corner of the image. The horizontal offsets (X) are the pixel counts to the right, and the vertical offsets (Y) are the pixel counts down. The location of the image portion is defined by the sequence of X coordinates (LEFT, RIGHT) and the Y coordinates (TOP, BOTTOM), of its bounding box. For the case of a fingertip, the first information item shall be “TIP”, and the second information item shall be “NA”. The next four information items are the horizontal and vertical offsets as defined above. The six information items within the field are separated by five “US” separators. This information will describe either the location of the entire joint image, one full finger view, or segment. Individual full finger or segment definitions may be repeated as subfields separated by the “RS” separator.

14.1.16 Field 14.016: Scanned horizontal pixel scale (SHPS)

This optional ASCII field shall specify the horizontal pixel density used for the scanning of the original impression providing the SLC field contains a "1" or a "2". Otherwise, it indicates the horizontal component of the pixel aspect ratio.

14.1.17 Field 14.017: Scanned vertical pixel scale (SVPS)

This optional ASCII field shall specify the vertical pixel density used for the scanning of the original impression providing the SLC field contains a "1" or a "2". Otherwise, it indicates the vertical component of the pixel aspect ratio.

14.1.18 Field 14.018: Amputated or bandaged (AMP)

This optional ASCII field shall specify if one or more fingers are amputated or bandaged. This field shall consist of one subfield for each amputated or missing finger. Each subfield shall contain two information items separated by the “US” separator. The first item is the finger number between one and ten as chosen from Table 12. The second item is the amputated or bandaged code (AMPCD). The following is a list of allowable indicators for the AMPCD:

Descriptor	AMPCD
Amputation	XX
Unable to print (e.g., bandaged)	UP

Multiple finger positions shall be separated by the “RS” separator. This field is to be used anytime there are fewer than expected printable fingers in a submission (e.g., less than four in a left or right slap or less than two in a two-thumb slap). A partially scarred finger should be printed.

14.1.19 Field 14.0019: Reserved for future definition (RSV)

These fields are reserved for inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

14.1.20 Field 14.020: Comment (COM)

This optional ASCII field may be used to insert comments or other ASCII text information with the image data.

14.1.21 Field 14.021: Finger segment position(s) (SEG)

This optional ASCII field shall contain offsets to the locations of image segments containing the individual fingers within the flat images of the four simultaneous fingers from each hand or the two simultaneous thumbs. The offsets are relative to the origin positioned in the upper left corner of the image. The horizontal offsets (X) are the pixel counts to the right, and the vertical offsets (Y) are the pixel counts down. A finger segment is defined by the FINGER NUMBER, the X coordinates (LEFT, RIGHT) and the Y coordinates (TOP, BOTTOM), of its bounding box. The five information items within a finger segment definition are separated by the “US” separator. Individual finger segment definitions are separated by the “RS” separator. If more than one algorithm is used to segment the image, successive sets finger segmentation positions shall be formatted as above and immediately follow the previous set.

14.1.22 Field 14.022: NIST quality metric (NQM)

This optional ASCII field shall contain the NIST Fingerprint Image Quality (NFIQ) scores for the individual finger(s) derived from the slap impressions or individual rolled fingerprints. It consists of two information items. The first item is the finger number between one and ten as chosen from Table 12. The second item is the quality score which is a quantitative expression of the predicted AFIS matcher accuracy performance of the fingerprint image. The scores range from "1" for the best quality image, to "5" for the worst quality image. A "254" indicates that no score was ever computed while an entry of "255" shall indicate a failed attempt to calculate the image quality metric. These two information items are separated by the “US” separator. Individual finger quality definitions are separated by the “RS” separator.

14.1.23 Field 14.023: Segmentation quality metric (SQM)

This optional ASCII field provides a measure of estimated correctness regarding the accuracy of the location of the segmented finger within the right or left four finger or two thumbs slap image. For each segmented finger, this field shall contain four information items separated by the "US" separator character. The first information item is the finger number between one and ten as chosen from Table 12.

The other three items identify a quality score and the algorithm used to create the quality score. This information is useful to enable the recipient of the quality score to differentiate between

quality scores generated by different algorithms and adjust for any differences in processing or analysis as necessary.

- The second information item shall be a measure of estimated correctness regarding the accuracy of the location of the segmented finger. This item contains the ASCII representation of the integer image quality score between 0 and 100 assigned to the image data by a quality algorithm. Higher values indicate better quality. An entry of "255" shall indicate a failed attempt to calculate a quality score. An entry of "254" shall indicate that no attempt to calculate a quality score was made. The use of additional values to convey other information should be harmonized with ISO/IEC 19794 standards.
- The third information item shall specify the ID of the vendor of the quality algorithm used to calculate the quality score. This 4-digit hex value is assigned by IBIA and expressed as four ASCII characters. The IBIA shall maintain the Vendor Registry of CBEFF Biometric Organizations that will map the value in this field to a registered organization.
- The fourth information item shall specify a numeric product code assigned by the vendor of the quality algorithm, which may be registered with the IBIA, but registration is not required. It indicates which of the vendor's algorithms was used in the calculation of the quality score. This field contains the ASCII representation of the integer product code and should be within the range 1 to 65535.

This subfield is repeated for each segmented finger whose coordinates appear in field 14.021. The "RS" character separates each set of four information items. For the case where more than one segmentation algorithm is applied to a multi-finger plain image, the set of segmentation information items for each finger shall be ordered corresponding to the entries in field 14.021.

14.1.24 Field 14.024: Fingerprint quality metric (FQM)

This optional ASCII field is used to specify one or more different metrics of fingerprint image quality score data for the image stored in this record. The meaning attributed to this metric must be defined and interpreted by the producer of the scoring algorithm or by the person or system used to assign the metric to the fingerprint image. The metric may be a predictor of AFIS matcher accuracy performance or a different metric to indicate a value associated with the quality of the fingerprint image for a particular function.

This field may contain one or more subfields, each consisting of four information items items separated by the "US" separator character. The first information item is the finger number as chosen from Table 12.

The other three items identify a quality score and the algorithm used to create the quality score. This information is useful to enable the recipient of the quality score to differentiate between quality scores generated by different algorithms and adjust for any differences in processing or analysis as necessary.

- The second information item shall be a quantitative expression of the predicted matching performance of the biometric sample. This item contains the ASCII representation of the integer image quality score between 0 and 100 assigned to the image data by a quality algorithm. Higher values indicate better quality. An entry of "255" shall indicate a failed attempt to calculate a quality score. An entry of "254" shall indicate that no attempt to

calculate a quality score was made. The use of additional values to convey other information should be harmonized with ISO/IEC 19794 standards.

- ∉ The third information item shall specify the ID of the vendor of the quality algorithm used to calculate the quality score. This 4-digit hex value is assigned by IBIA and expressed as four ASCII characters. The IBIA shall maintain the Vendor Registry of CBEFF Biometric Organizations that will map the value in this field to a registered organization.
- ∉ The fourth information item shall specify a numeric product code assigned by the vendor of the quality algorithm, which may be registered with the IBIA, but registration is not required. It indicates which of the vendor's algorithms was used in the calculation of the quality score. This field contains the ASCII representation of the integer product code and should be within the range 1 to 65535.

This subfield is repeated for each finger image and quality algorithm used, separated by the "RS" character.

14.1.25 Field 14.025: Alternate Finger segment position(s) (ASEG)

This optional ASCII field is an alternate approach to describing the locations for each of the image segments of the individual fingers within a flat image containing the capture of four simultaneous fingers or two simultaneous thumbs. This field uses an n-vertex polygon to encompass each finger image segment, where "n" is between 3 and 99. The order of the vertices must 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 must be a simple, plane figure with no sides crossing and no interior holes. This field shall consist of one to four subfields. Each subfield shall consist of a finger number between 1 and 10, the total number of vertices of the polygon encompassing the finger, and the set of consecutive vertices. Each vertex shall be represented as horizontal and vertical pixel offsets relative to the origin positioned in the upper left corner of the image. The horizontal offsets (X) are the pixel counts to the right, and the vertical offsets (Y) are the pixel counts down from the origin. A minimum of three points is required to describe a finger location. A "US" character shall be used to separate the finger number, the number of vertices, each X coordinate, and each Y coordinate. Subfields representing each finger are delimited by the "RS" separator character.

14.1.20 Field 14.020: Comment (COM)

This optional field may be used to insert comments or other ASCII text information with the tenprint image data.

14.1.16 Field 14.021-199: Reserved for future definition (RSV)

These fields are reserved for inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

14.1.17 Fields 14.200-998: User-defined fields (UDF)

These fields are user-definable fields. Their size and content shall be defined by the user and be in accordance with the receiving agency. If present they shall contain ASCII textual information.

14.1.18 Field 14.999: Image data (DAT)

This field shall contain all of the data from a captured tenprint image. It shall always be assigned field number 999 and must be the last physical field in the record. For example, "14.999:" is followed by image data in a binary representation.

Each pixel of uncompressed grayscale data shall normally be quantized to eight bits (256 gray levels) contained in a single byte. If the entry in BPX Field 14.012 is greater or less than "8", the number of bytes required to contain a pixel will be different. If compression is used, the pixel data shall be compressed in accordance with the compression technique specified in the CGA field.

14.2 End of Type-14 variable-resolution tenprint image record

For the sake of consistency, immediately following the last byte of data from field 14.999 an "FS" separator shall be used to separate it from the next logical record. This separator must be included in the length field of the Type-14 record.

14.3 Additional variable-resolution tenprint image records

Additional Type-14 records may be included in the file. For each additional tenprint image, a complete Type-14 logical record together with the "FS" separator is required.

15 Type-15 variable-resolution palmprint image record

The Type-15 tagged-field logical record shall contain and be used to exchange palmprint image data together with fixed and user-defined textual information fields pertinent to the digitized image. Information regarding the scanning resolution used, the image size and other parameters or comments required to process the image are recorded as tagged-fields within the record. Palmprint images transmitted to other agencies will be processed by the recipient agencies to extract the desired feature information required for matching purposes.

The image data shall be acquired directly from a subject using a live-scan device, or from a palmprint card or other media that contains the subject's palmprints.

Any method used to acquire the palmprint images shall be capable of capturing a set of images for each hand. This set shall include the writer's palm as a single scanned image, and the entire area of the full palm extending from the wrist bracelet to the tips of the fingers as one or two scanned images. If two images are used to represent the full palm, the lower image shall extend from the wrist bracelet to the top of the interdigital area (third finger joint) and shall include the thenar, and hypothenar areas of the palm. The upper image shall extend from the bottom of the interdigital area to the upper tips of the fingers. This provides an adequate amount of overlap between the two images that are both located over the interdigital area of the palm. By matching the ridge structure and details contained in this common area, an examiner can confidently state that both images came from the same palm.

As a palmprint transaction may be used for different purposes, it may contain one or more unique image areas recorded from the palm or hand. A complete palmprint record set for one individual will normally include the writer's palm and the full palm image(s) from each hand. Since a tagged-field logical image record may contain only one binary field, a single Type-15 record will be required for each writer's palm and one or two Type-15 records for each full palm. Therefore, four to six Type-15 records will be required to represent the subject's palmprints in a normal palmprint transaction.

15.1 Fields for the Type-15 logical record

The following paragraphs describe the data contained in each of the fields for the Type-15 logical record.

Within a Type-15 logical record, entries shall be provided in numbered fields. It is required that the first two fields of the record are ordered, and the field containing the image data shall be the last physical field in the record. For each field of the Type-15 record, Table 13.1 lists the "condition code" as being mandatory "M" or optional "O", the field number, the field name, character type, field size, and occurrence limits. Based on a three digit field number, the maximum byte count size for the field is given in the last column. As more digits are used for the field number, the maximum byte count will also increase. The two entries in the "field size per occurrence" include all character separators used in the field. The "maximum byte count" includes the field number, the information, and all the character separators including the "GS" character.

15.1.1 Field 15.001: Logical record length (LEN)

This mandatory ASCII field shall contain the total count of the number of bytes in the Type-15 logical record. Field 15.001 shall specify the length of the record including every character of every field contained in the record and the information separators.

15.1.2 Field 15.002: Image designation character (IDC)

This mandatory ASCII field shall be used to identify the palmprint image contained in the record. This IDC shall match the IDC found in the file content (CNT) field of the Type-1 record.

15.1.3 Field 15.003: Impression type (IMP)

This mandatory one-byte ASCII field shall indicate the manner by which the palmprint image information was obtained. The appropriate code selected from Table 13.2 shall be entered in this field.

15.1.4 Field 15.004: Source agency/ORI (SRC)

This mandatory ASCII field shall contain the identification of the administration or organization that originally captured the facial image contained in the record. Normally, the Originating Agency Identifier (ORI) of the agency that captured the image will be contained in this field. It consists of two information items in the following format:

CC/*agency*

The first information item contains the Interpol Country Code, two alpha-numeric characters long. The second item, *agency*, is a free text identification of the agency, up to a maximum of 32 alpha-numeric characters.

15.1.5 Field 15.005: Palmprint capture date (PCD)

This mandatory ASCII field shall contain the date that the palmprint image was captured. The date shall appear as eight digits in the format CCYYMMDD. The CCYY characters shall represent the year the image was captured; the MM characters shall be the tens and units values of the month; and the DD characters shall be the tens and units values of the day in the month. For example, the entry 20000229 represents February 29, 2000. The complete date must be a legitimate date.

15.1.6 Field 15.006: Horizontal line length (HLL)

This mandatory ASCII field shall contain the number of pixels contained on a single horizontal line of the transmitted image.

15.1.7 Field 15.007: Vertical line length (VLL)

This mandatory ASCII field shall contain the number of horizontal lines contained in the transmitted image.

15.1.8 Field 15.008: Scale units (SLC)

This mandatory ASCII field shall specify the units used to describe the image sampling frequency (pixel density). A "1" in this field indicates pixels per inch, or a "2" indicates pixels per centimeter. A "0" in this field indicates no scale is given. For this case, the quotient of HPS/VPS gives the pixel aspect ratio.

15.1.9 Field 15.009: Horizontal pixel scale (HPS)

This mandatory ASCII field shall specify the integer pixel density used in the horizontal direction providing the SLC contains a "1" or a "2". Other-wise, it indicates the horizontal component of the pixel aspect ratio.

15.1.10 Field 15.010: Vertical pixel scale (VPS)

This mandatory ASCII field shall specify the integer pixel density used in the vertical direction providing the SLC contains a "1" or a "2". Otherwise, it indicates the vertical component of the pixel aspect ratio.

Ident	Cond. code	Field Number	Field Name	Char type	Field size per occurrence		Occur count		Max byte count
					min.	max.	min	max	
LEN	M	15.001	LOGICAL RECORD LENGTH	N	4	8	1	1	15
IDC	M	15.002	IMAGE DESIGNATION CHARACTER	N	2	5	1	1	12
IMP	M	15.003	IMPRESSION TYPE	N	2	2	1	1	9
SRC	M	15.004	SOURCE AGENCY / ORI	AN	6	35	1	1	42
PCD	M	15.005	PALMPRINT CAPTURE DATE	N	9	9	1	1	16
HLL	M	15.006	HORIZONTAL LINE LENGTH	N	4	5	1	1	12
VLL	M	15.007	VERTICAL LINE LENGTH	N	4	5	1	1	12
SLC	M	15.008	SCALE UNITS	N	2	2	1	1	9
HPS	M	15.009	HORIZONTAL PIXEL SCALE	N	2	5	1	1	12
VPS	M	15.010	VERTICAL PIXEL SCALE	N	2	5	1	1	12
CGA	M	15.011	COMPRESSION ALGORITHM	AN	5	7	1	1	14
BPX	M	15.012	BITS PER PIXEL	N	2	3	1	1	10
PLP	M	15.013	PALMPRINT POSITION	N	2	3	1	1	10
RSV		15.014 15.019	RESERVED FOR FUTURE INCLUSION	--	--	--	--	--	--
COM	O	15.020	COMMENT	AN	2	128	0	1	128
RSV		15.021 15.199	RESERVED FOR FUTURE INCLUSION	--	--	--	--	--	--
UDF	O	15.200 15.998	USER-DEFINED FIELDS	--	--	--	--	--	--
DAT	M	15.999	IMAGE DATA	B	2	--	1	1	--

Table 44 Type-14 variable-resolution palmprint record layout

Description	Code
Live-scan palm	10
Nonlive-scan palm	11
Latent palm impression	12
Latent palm tracing	13
Latent palm photo	14
Latent palm lift	15

Table 45 Palm Impression Type

15.1.11 Field 15.011: Compression algorithm (CGA)

This mandatory ASCII field shall specify the algorithm used to compress grayscale images. An entry of "NONE" in this field indicates that the data contained in this record is uncompressed. For those images that are to be compressed, this field shall contain the preferred method for the compression of tenprint fingerprint images. Valid compression codes are defined in Table A7.1.

15.1.12 Field 15.012: Bits per pixel (BPX)

This mandatory ASCII field shall contain the number of bits used to represent a pixel. This field shall contain an entry of "8" for normal grayscale values of "0" to "255". Any entry in this field greater than or less than "8" shall represent a grayscale pixel with increased or decreased precision respectively.

Palm Position	Palm code	Image area (mm^2)	Width (mm)	Height (mm)
Unknown Palm	20	28387	139.7	203.2
Right Full Palm	21	28387	139.7	203.2
Right Writer s Palm	22	5645	44.5	127.0
Left Full Palm	23	28387	139.7	203.2
Left Writer s Palm	24	5645	44.5	127.0
Right Lower Palm	25	19516	139.7	139.7
Right Upper Palm	26	19516	139.7	139.7
Left Lower Palm	27	19516	139.7	139.7
Left Upper Palm	28	19516	139.7	139.7
Right Other	29	28387	139.7	203.2
Left Other	30	28387	139.7	203.2

Table 46 Palm Codes, Areas & Sizes

15.1.13 Field 15.013: Palmprint position (PLP)

This mandatory tagged-field shall contain the palmprint position that matches the palmprint image. The decimal code number corresponding to the known or most probable palmprint position shall be taken from Table 13.3 and entered as a two-character ASCII subfield. Table

13.3 also lists the maximum image areas and dimensions for each of the possible palmprint positions.

15.1.14 Field 15.014-019: Reserved for future definition (RSV)

These fields are reserved for inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

15.1.15 Field 15.020: Comment (COM)

This optional field may be used to insert comments or other ASCII text information with the palmprint image data.

15.1.16 Field 15.021-199: Reserved for future definition (RSV)

These fields are reserved for inclusion in future revisions of this standard. None of these fields are to be used at this revision level. If any of these fields are present, they are to be ignored.

15.1.17 Fields 15.200-998: User-defined fields (UDF)

These fields are user-definable fields. Their size and content shall be defined by the user and be in accordance with the receiving agency. If present they shall contain ASCII textual information.

15.1.18 Field 15.999: Image data (DAT)

This field shall contain all of the data from a captured palmprint image. It shall always be assigned field number 999 and must be the last physical field in the record. For example, "15.999:" is followed by image data in a binary representation. Each pixel of uncompressed grayscale data shall normally be quantized to eight bits (256 gray levels) contained in a single byte. If the entry in BPX Field 15.012 is greater or less than 8, the number of bytes required containing a pixel will be different. If compression is used, the pixel data shall be compressed in accordance with the compression technique specified in the CGA field.

15.2 End of Type-15 variable-resolution palmprint image record

For the sake of consistency, immediately following the last byte of data from field 15.999 an "FS" separator shall be used to separate it from the next logical record. This separator must be included in the length field of the Type-15 record.

15.3 Additional Type-15 variable-resolution palmprint image records

Additional Type-15 records may be included in the file. For each additional palmprint image, a complete Type-15 logical record together with the “FS” separator is required.

16 Another individual

If fingerprint or other biometric data for another individual is to be recorded or transmitted, a new file shall be generated for that individual using the same format as described previously.

APPENDIX 1 ASCII Separator Codes

ASCII	Position[1]	Description
FS	1/12	Separates logical records of a file.
GS	1/13	Separates fields of a logical record.
RS	1/14	Separates the subfields of a record field.
US	1/15	Separates individual information items of the field or subfield.

[1] This is the position as defined in the ASCII standard.

APPENDIX 2 Calculation of Alpha-Numeric Check Character

For TCN and TCR (Fields 1.09 and 1.10):

The number corresponding to the check character is generated using the following formula:

$$(YY * 10^8 + SSSSSSSS) \text{ Modulo } 23$$

where YY and SSSSSSSS are the numerical values of the last two digits of the year and the serial number respectively.

The check character is then generated from the look-up table given below.

For CRO (Field 2.010)

The number corresponding to the check character is generated using the following formula:

$$(YY * 10^6 + NNNNNN) \text{ Modulo } 23$$

where YY and NNNNNN are the numerical values of the last two digits of the year and the serial number respectively.

The check character is then generated from the look-up table given below.

Check Character Look-up Table

1-A	9-J	17-T
2-B	10-K	18-U
3-C	11-L	19-V
4-D	12-M	20-W
5-E	13-N	21-X
6-F	14-P	22-Y
7-G	15-Q	0-Z
8-H	16-R	

APPENDIX 3 Mnemonic Codes

A3.1 Mnemonics for Type-1 Logical Records

mnemonic	field	para
CNT	File Content	1.003
DAI	Destination Agency Identifier	1.007
DAT	Date of Transaction	1.005
DCS	Directory of Character Sets	1.015
DOM	Domain Name	1.013
GMT	Greenwich Mean Time	1.014
LEN	Logical Record Length	1.001
NSR	Native Scanning Resolution	1.011
NTR	Nominal Transmitting Resolution	1.012
ORI	Originating Agency Identifier	1.008
PRY	Priority	1.006
TCN	Transaction Control Number	1.009
TCR	Transaction Control Response	1.010
TOT	Type of Transaction	1.004
VER	Version Number	1.002

A3.2 Mnemonics for Types of Transaction (TOT)

mnemonic	transaction type
APC	Add to Print Collection (incl. Photo)
ATP	Add to Print Collection
CPP	Criminal Photo-to-Photo Search
CPS	Criminal Print-to-Print Search
CPR	Criminal Subject Photo Request
DBS	Database Search
DFP	Delete from Print Collection
DIP	Disregard Individual Print Update
DPC	Delete Form Photo Collection
ERR	Error Message
IMR	Image Response
IRQ	Image Request
MMS	Latent-to-Latent Search
MPS	Latent-to-Print Search
NPP	Non-Criminal Photo-to-Photo Search
NPS	Non-Criminal Print-to-Print Search
PHR	Photo Response
PMS	Print-to-Latent Search
SRE	Search Results
SUP	Substitute Prints into Existing Ten-Print
UPR	Update Request
USA	Add Latent to Unidentified Latent Collection

mnemonic	transaction type
USR	Remove Latent from Unidentified Latent Collection

A3.3 Mnemonics for Type-2 Logical Records

mnemonic	field	para
ADD	Address	2.032
AKA	Aliases	2.034
ALF	Alert Flag	2.067
ARI	Additional Response Information	2.085
BLD	Build	2.042
BRT	Broadcast Request To	2.080
CCP	Coarse Classification of Patterns	2.027
CNO	Case Number	2.007
COL	Color	2.040
COU	Recipient Countries	2.065
CRN	Criminal Reference Number	2.010
DAR	Date of Record	2.004
DBR	Date of Birth Range	2.036
DLU	Date of Last Update	2.005
DOB	Date of Birth	2.035
DON	Date of Notice	2.024
DOO	Date of Offence	2.055
DOR	Date of Offence Range	2.056
DPR	Date Fingerprinted	2.019
DSG	Date Signature	2.073
DSR	Date of Crime Search Range	2.057
ERM	Status/Error Message Field	2.074
FAC	Face	2.044
FCP	Fine Classification of Patterns	2.028
FFN	Father´s Family Name	2.075
FIB	Fingerprint Identification Byte	2.018
FNU	Finger Number	2.017
FPR	Finger Present	2,083
GAC	Geographical Area of Crime	2.052
GSA	Geographical Search Area	2.053
HAI	Hair	2.043
HGT	Height	2.041
ICP	ICPO/GS	2.062
IDC	Image Designation Character	2.002
IDF	Identified Flag	2.069
INF	Additional Information	2.063
LAN	Languages Spoken	2.045
LEN	Logical Record Length	2.001
MAR	Latents etc	2.048
MDO	Modus Operandi	2.051
MID	Latent Identifier	2.009
MMN	Mother´s Maiden Name	2.076

mnemonic	field	para
MN1	Miscellaneous Identification Number	2.012
MN2	Miscellaneous Identification Number	2.013
MN3	Miscellaneous Identification Number	2.014
MN4	Miscellaneous Identification Number	2.015
MN5	Miscellaneous Identification Number	2.016
MNA	Maiden Name	2.031
MPF	Latent Priority Flag	2.070
NAM	Name	2.030
NAT	Nationality	2.038
NLF	Nominal File	2.029
OBU	Owning Bureau	2.023
OCC	Occupation	2.049
ORN	Other Reference Number	2.011
OTY	Offence Type	2.054
PHO	Photograph Number	2.046
POA	Place Of Arrest	2.022
POB	Place of Birth	2.037
PSP	Passport Number	2.047
QLM	Quality Measure	2.026
RES	Result	2.066
RFP	Reason Fingerprinted	2.021
RLS	Respondents List	2.064
RNK	Rank	2.072
SCT	Send Copy To	2.006
SEX	Sex	2.039
SIM	Station Inputting Latent	2.025
SQN	Sequence Number	2.008
SYS	System Information	2.003
TCF	Target Criminal Flag	2.068
TLM	Time Limit	2.061
TOF	Time of Fingerprint	2.020
TOO	Time of Offence	2.058
TOR	Time of Offence Range	2.059
TRU	True Identity	2.033
TSR	Time of Crime Search Range	2.060
TUF	Tie Up Flag	2.071
WNG	Warning	2.050

A3.4 Mnemonics for Type-4 Logical Records

mnemonic	field	para
FGP	Finger Position	4.004
GCA	Grey-scale Compression Algorithm	4.008
HLL	Horizontal Line Length	4.006
IDC	Image Designation Character	4.002
IMP	Impression Type	4.003
ISR	Image Scanning Resolution	4.005

mnemonic	field	para
LEN	Logical Record Length	4.001
VLL	Vertical Line Length	4.007

A3.5 Mnemonics for Type-7 Logical Records

mnemonic	field	para
GCA	Grey-scale Compression Algorithm	7.009
HLL	Horizontal Line Length	7.007
IDC	Image Designation Character	7.002
IMD	Image Description	7.004
IMR	Image Capture Resolution	7.006
IMT	Image Type	7.003
LEN	Logical Record Length	7.001
PCN	Pattern Classification	7.005
VLL	Vertical Line Length	7.008

A3.6 Mnemonics for Type-9 Logical Records

mnemonic	field	para
LEN	Logical Record Length	9.001
IDC	Image Designation Character	9.002
IMP	Impression Type	9.003
FMT	Minutiæ Format	9.004
	CBEFF Information	9.126
	Capture Equipment Identification	9.127
HLL	Horizontal Line Length	9.128
VLL	Vertical Line Length	9.129
SLC	Scale Units	9.130
HPS	Horizontal Pixel Scale	9.131
VPS	Vertical Pixel Scale	9.132
	Finger View	9.133
FGP	Finger Position	9.134
	Finger Quality	9.135
	Number of minutiæ	9.136
	Finger minutiæ data	9.137
	Ridge count information	9.138
	Core information	9.139
	Delta information	9.140

A3.7 Mnemonics for Type-10 Logical Records

mnemonic	field	para
CGA	Compression Algorithm	10.011
COL	Color	10.043
CSP	Colorspace	10.012

mnemonic	field	para
DMM	Device Monitoring Mode	10.030
HLL	Horizontal Line Length	10.006
HPS	Horizontal Pixel Scale	10.009
IDC	Image Designation Character	10.002
IMT	Image Type	10.003
LEN	Logical Record Length	10.001
PAS	Photo Acquisition Source	10.023
PHD	Photo Date	10.005
POA	Pose Offset Angle	10.021
POS	Subject Pose	10.020
PXS	Photo Description	10.022
RSV	Reserved	
SAP	Subject Acquisition Profile	10.013
SEC	Subject Eye Color	10.027
SFP	Facial Feature Points	10.029
SHC	Subject Jair Color	10.028
SHPS	Scan Hor Pixel Scale	10.016
SLC	Scale Units	10.008
SMD	SMT Descriptors	10.042
SMS	SMT Size	10.041
SMT	NCIC Designation Code	10.040
SPA	Subject Pose Angles	10.025
SQS	Subject Quality Score	10.023
SRC	Source Agency	10.004
SVPS	Scan Vert Pixel Scale	10.017
SXS	Subject Facial Decription	10.026
UDF	User Defined Fields	
VLL	Vertical Line Length	10.007
VPS	Vertical Pixel Scale	10.010

A3.8 Mnemonics for Type-13 Logical Records

mnemonic	field	para
BPX	Bits per Pixel	13.012
CGA	Compression Algorithm	13.011
COM	Comment	13.020
DAT	Image Data	13.999
FGP	Finger Position	13.013
HLL	Horizontal Line Length	13.006
HPS	Horizontal Pixel Scale	13.009
IDC	Image Designation Character	13.002
IMP	Impression Type	13.003
LCD	Latent Capture Data	13.005
LEN	Logical Record Length	13.001
LQM	Latent Qualtiy Metric	13.024
PPC	Print Position Coordinates	13.015
RSV	Reserved	

mnemonic	field	para
SHPS	Scanned Horizontal Pixel Scale	13.016
SLC	Scale Units	13.008
SPD	Search Position Descriptors	13.014
SRC	Source Agency	13.004
SVPS	Scannes Vertical Pixel Scale	13.017
UDF	User Defined Fields	
VLL	Vertical Line Length	13.007
VPS	Vertical Pixel Scale	13.010

A3.9 Mnemonics for Type-14 Logical Records

mnemonic	field	para
BPX	Bits per Pixel	14.012
CGA	Compression Algorithm	14.011
COM	Comment	14.020
DAT	Image Data	14.999
FGP	Finger Position	14.013
HLL	Horizontal Line Length	14.006
HPS	Horizontal Pixel Scale	14.009
IDC	Image Designation Character	14.002
IMP	Impression Type	14.003
LEN	Logical Record Length	14.001
RSV	Reserved	
SLC	Scale Units	14.008
SRC	Source Agency	14.004
TCD	Tenprint Capture Date	14.005
UDF	User Defined Fields	
VLL	Vertical Line Length	14.007
VPS	Vertical Pixel Scale	14.010

A3.10 Mnemonics for Type-15 Logical Records

mnemonic	field	para
BPX	Bits per Pixel	15.012
CGA	Compression Algorithm	15.011
COM	Comment	15.020
DAT	Image Data	15.999
HLL	Horizontal Line Length	15.006
HPS	Horizontal Pixel Scale	15.009
IDC	Image Designation Character	15.002
IMP	Impression Type	15.003
LEN	Logical Record Length	15.001
PCD	Palmprint Capture Date	15.005
PLP	Palmprint Position	15.013
RSV	Reserved	
SLC	Scale Units	15.008

mnemonic	field	para
SRC	Source Agency	15.004
UDF	User Defined Fields	
VLL	Vertical Line Length	15.007
VPS	Vertical Pixel Scale	15.010

APPENDIX 4 JPEG File Interchange Format

JPEG File Interchange Format

Version 1.02
September 1, 1992
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Why a File Interchange Format

JPEG File Interchange Format (JFIF) is a minimal file format, which enables JPEG bitstreams to be exchanged between a wide variety of platforms and applications. This minimal format does not include any of the advanced features found in the TIFF JPEG specification or any application specific file format. The only purpose of this simplified format is to allow the exchange of JPEG compressed images.

JPEG File Interchange Format features

- Uses JPEG compression
- Uses JPBG interchange format compressed image representation
- PC or Mac or UNIX workstation compatible
- Standard color space: one or three components. For three components YCbCr (CCIR 601-256 levels)
- APP0 marker used to specify Units, X pixel density, Y pixel density, thumbnail
- APP0 marker also used to specify JFIF extensions
- APP0 mater also used to specify application-specific information

JPEG Compression

Although any JPEG process is supported by the syntax of the JFIF it is strongly recommended that the JPEG baseline process be used for the purposes of file interchange. This ensures maximum compatibility with all applications supporting JPEG. JFIF conforms to the JPEG Draft International Standard (ISO DIS 10917-1).

The JFIF is entirely compatible with the standard JPEG interchange format; the only additional requirement is the mandatory presence of the APP0 marker right after the SOI marker. Note that the JPEG interchange format requires (as does JFIF) all table specifications used in the encoding process be coded in the bitstream prior to their use.

Compatible across Platforms

The JFIF is compatible across platforms: for example, it can use any resource forks supported by the Macintosh and by PCs or workstations, but not just one platform.

Standard color Space

The color space to be used is YCbCr as defined by CCIR 601(256 levels). The RGB components calculated by linear conversion from YCbCr shall not be gamma corrected (gamma = 1.0). If only one component is used, that component shall be Y.

APP0 marker is used to identify JPEG FIF

- The APP0 marker is used to identify a JPEG FIF file.
- The JPEG FIF APP0 marker is mandatory right after the SOI marker.
- The JFIF APP0 marker is identified by a zero terminated string: *"JFIF"*.
- The APP0 can be used for any other purpose by the application provided it can be distinguished from the JFIF APP0.
- The JFIF APP0 marker provides information which is missing from the JPEG stream: version number, X and Y pixel density (dots per inch or dots per cm), pixel aspect ratio (derived from X and Y pixel density), thumbnail.

APP0 marker used to specify JFIF extensions

Additional APP0 marker segment(s) can optionally be used to specify JFIF extensions. If used, these segments must immediately follow the JFIF APP0 marker. Decoders should skip any unsupported JFIF extension segments and continue decoding.

The JFIF extension APP0 marker is identified by a zero terminated string: *"JFXX"*. The JFIF extension APP0 marker segment contains a 1-byte code, which identifies the extension. This version, version 1.02, has only one extension defined: an extension for defining thumbnails stored in formats other than 24-bit RGB.

APP0 marker used for application-specific information

Additional APP0 marker segments can be used to hold application-specific information which does not affect the decodability or displayability of the JFIF file. Application-specific APP0 marker segments must appear after the JFIF APP0 and any JFXX APP0 segments. Decoders should skip any unrecognized application-specific APP0 segments.

Application-specific APP0 marker segments are identified by a zero terminated string which identifies the application (not "*JFIF*" or *"JFXX"*). This string should be an organization name or company trademark. Generic strings such as dog, cat, tree, etc. should not be used.

Conversion to and from RGB

Y, Cb, and Cr are converted from R, G, and B as defined in CCIR Recommendation 601 but are normalized so as to occupy the full 256 levels of an 8-bit binary encoding. More precisely:

$$Y = 256 * E'y$$
$$Cb = 256 * [E'_{Cb}] + 128$$
$$Cr = 256 * [E'_{Cr}] + 128$$

where the E'_y E'_{Cb} and E'_{Cr} are defined as in CCIR 601. Since values of E'_y have a range of 0 to 1.0 and those for E'_{Cb} and E'_{Cr} have a range of -0.5 to +0.5, Y, Cb, and Cr must be clamped to 255 when they are maximum value.

RGB to YCbCr Conversion

YCbCr (256 levels) can be computed directly from 8-bit RGB as follows:

$$Y = 0.299\ R + 0.587G + 0.114B$$
$$Cb = -0.1687\ R - 0.3313\ G + 0.5\ B + 128$$
$$Cr = 0.5R - 0.4177\ G - 0.0813\ B + 128$$

NOTE - Not all image file formats store image samples in the order R_0, G_0, B_0, ... R_n, G_n, B_n. B_e be sure to verify the sample order before converting an RGB file to JFIF.

YCbCr to RGB Conversion

RGB can be computed directly from YCbCr (256 levels) as follows:

$$R = Y + 1.402\ (Cr - 128)$$
$$G = Y - 0.34414\ (Cb - 128) - 0.71414\ (Cr - 128)$$
$$B = Y + 1.772\ (Cb - 128)$$

Image Orientation

In JFIF files, the image orientation is always top-down. This means that the first image samples encoded in a JFIF file are located in the upper left hand corner of the image and encoding proceeds from left to right and top to bottom. Top-down orientation is used for both the full resolution image and the thumbnail image.

The process of converting an image file having bottom-up orientation to JFIF must include inverting the order of all image lines before JPEG encoding.

Spatial Relationship of Components

Specification of the spatial positioning of pixel samples within components relative to the samples of other components is necessary for proper image post processing and accurate image presentation. In JFIF files, the positions of the pixels in subsampled components are defined with respect to the highest resolution component. Since components must be sampled orthogonally (along rows and columns), the spatial position of the samples in a given subsampled component may be determined by specifying the horizontal and vertical offsets of the first sample, i.e. the sample in the upper left corner, with respect to the highest resolution component.

The horizontal and vertical offsets of the first sample in a subsampled component, $Xoffset_i\ [0,0]$ and $Yoffset_i\ [0,0]$, are defined to be:

$$Xoffset_i[0,0] = ((Nsamples_{ref} / Nsamples_j) / 2) - 0.5$$
$$Yoffset_i[0,0] = ((Nlines_{ref} / Nlines_i) / 2) - 0.5$$

where

$Nsamples_{ref}$ is the number of samples per line in the largest component;
$Nsamples_i$ is the number of samples per line in the i^{th} component;

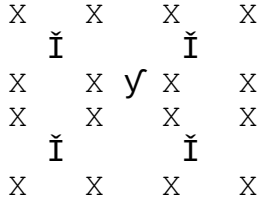
$Nlines_{ref}$ is the number of lines in the largest component;
$Nlines_i$ is the number of lines in the i^{th} component.

Proper subsampling of components incorporates an anti-aliasing filter which reduces the spectral bandwidth of the full resolution components. Subsampling can easily be accomplished using a symmetrical digital filter with an even number of taps (coefficients). A commonly used filter for 2:1 subsampling utilizes two taps (1/2,1/2).

As an example, consider a 3 component image which is comprised of components having the following dimensions:

Component 1: 256 samples, 288 lines
Component 2: 128 samples, 144 lines
Component 3: 64 samples, 96 lines

In a JFIF file, centers of the samples are positioned as illustrated below:



where x Component 1
Ĭ Component 2
y Component 3

NOTE - This definition is compatible with industry standards such as Postscript Level 2 and QuickTime. This definition is not compatible with the conventions used by CCIR Recommendation 601-I and other digital video formats. For these formats, pre-processing of the chrominance components is necessary prior to compression in order to ensure accurate reconstruction of the compressed image.

JPEG FiIe Interchange Format Specification

The syntax of a JFIF file conforms to the syntax for interchange format defined in Annex B of ISO DIS 10917-1. In addition, a JFIF file uses APP0 marker segments and constrains certain parameters in the frame header as defined below.

X'FF', SOI

X'FF', APP0, length, identifier, version, units, Xdensity,Ydensity, Xthumbnail, Ythumbnail, $(RGB)_n$

length	(2 bytes)	Total APP0 field byte count, including the byte count value (2 bytes), but excluding the APP0 marker itself
identifier	(5 bytes)	= X'4A', X'46', X'49', X'46', X'00' This zero terminated string ("JFIF")

		Uniquely identifies this APP0 marker. This string shall have zero parity (bit 7=0).
version	(2 bytes)	= X'0102' The most significant byte is used for major revisions, the least significant byte for minor revisions. Version 1.02 is the current released revision.
units	(1 byte)	Units for the X and Y densities units = 0: no units, X and Y specify the pixel units = 1: X and Y are dots per inch units = 2: X and Y are dots per cm
Xdensity	(2 bytes)	Horizontal pixel density
Ydensity	(2 bytes)	Vertical pixel density
Xthumbnail	(1 byte)	Thumbnail horizontal pixel count
Ythumbnail	(1 byte)	Thumbnail vertical pixel count
$(RGB)_n$	(3n bytes)	Packed (24-bit) RGB values for the thumbnail pixels, n = Xthumbnail * Ythumbnail

[Optional JFIF extension APP0 marker segment(s) - see below]

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X 'FF', SOFn, length,. frame parameters

Number of components	Nf	= 1 or 3
1st component	C1	= 1 = Y component
2nd component	C2	= 2 = Cb component
3rd component	C3	= 3 = Cr component

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X 'FF', EOI

JFIF Extension APP0 Marker Segment

Immediately following the JFIF APP0 marker segment may be a JFIF extension APP0 marker. This JFIF extension APP0 marker segment may only be present for JFIF versions 1.02 and above. The syntax of the JFIF extension APP0 marker segment is:

X 'FF', APP0,. Length, identifier, extension code, extension data

length	(2 bytes)	Total APP0 field byte count, including the byte count value (2 bytes), but excluding the APP0 marker itself
identifier	(5 bytes)	= X '4A', X ‘461, X '58', X '58', X ‘00’ This zero terminated string ("JFXX") uniquely identifies this APP0 marker. This string shall have zero parity (bit 7 = 0).
extension_code	(1 byte)	= Code which identifies the extension. In this version, the following extensions are defined: = X '10' Thumbnail coded using JPEG = X '11’ Thumbnail stored using 1 byte/pixel = X '13’ Thumbnail stored using 3 bytes/pixel
extension_data	(variable)	= The specification of the remainder of the JFIF extension APP0 marker segment varies with the extension. See below for a specification of extension_data for each extension.

JFIF Extension: Thumbnail coded using JPEG

This extension supports thumbnails compressed using JPEG. The compressed thumbnail immediately follows the extension-code (X ‘*I0*') in the extension_data field and the length of the compressed data must be included in the JFIF extension APP0 marker length field.

The syntax of the extension_data field conforms to the syntax for interchange format defined in Annex B of ISO DIS 10917-1. However, no "JFIF" or "JFXX" marker segments shall be present. As in the full resolution image of the JFIF file, the syntax of extension_data constrains parameters in the frame header as defined below:

X 'FF', SOI
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X'FF'. SOFn, length, frame parameters

Number of components Nf = 1 or 3
1st component C_1 = 1 = Y component
2nd component C_2 = 2 = Cb component
3rd component C_3 = 3 = Cr component
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ŏ
X 'FF', EOI

JFIF Extension: Thumbnail stored using one byte per pixel

This extension supports thumbnails stored using one byte per pixel and a color palette in the extension_data field. The syntax of extension_data is:

Xthumbnail	(I byte)	Thumbnail horizontal pixel count

Ythumbnail	(1 byte)	Thumbnail vertical pixel count
palette	(768 bytes)	24-bit RGB pixel values for the color palette. The RGB values define the colors represented by each value of an 8-bit binary encoding (0 - 255).
$(pixel)_n$	(n bytes)	8-bit values for the thumbnail pixels n = Xthumbnail * Ythumbnail

JFIF Extension: Thumbnail stored using three bytes per pixel

This extension supports thumbnails stored using three bytes per pixel in the extension_data field. The syntax of extension_data is:

Xthumbnail	(1 byte)	Thumbnail horizontal pixel count
Ythumbnail	(1 byte)	Thumbnail vertical pixel count
$(RGB)_n$	(3n bytes)	Packed (24-bit) RGB values for the thumbnail pixels, n = Xthumbnail * Ythumbnail

Useful tips

- You can identify a JFIF file by looking for the following sequence: X'FF', SOI, X'FF', APP0, <2 bytes to be skipped>, "JFIF", X'00'.
- If you use APP0 elsewhere, be sure not to have the strings "JFIF" or "JFXX" right after the APP0 marker.
- If you do not want to include a thumbnail, just program Xthumbnail = Ythumbnail = 0. Be sure to check the version number in the special APP0 field. In general, if the major version number of the JFIF file matches that supported by the decoder, the file will be decodable.
- If you only want to specify a pixel aspect ratio, put 0 for the units field in the special APP0 field. Xdensity and Ydensity can then be programmed for the desired aspect ratio.
- Xdensity = 1, Ydensity = 1 will program a 1:1 aspect ratio. Xdensity and Ydensity should always be non-zero.

APPENDIX 5 Character Codes

A5.1 7-bit ANSI code for information interchange

ASCII Character Set										
+	0	1	2	3	4	5	6	7	8	9
30				!	"	#	$	%	&	'
40	(	)	*	+	,	-	.	/	0	1
50	2	3	4	5	6	7	8	9	:	;
60	<	=	>	?	@	A	B	C	D	E
70	F	G	H	I	J	K	L	M	N	O
80	P	Q	R	S	T	U	V	W	X	Y
90	Z	[	\	]	^	_	`	a	b	c
100	d	e	f	g	h	i	j	k	l	m
110	n	o	p	q	r	s	t	u	v	w
120	x	y	z	{	|	}	~			

APPENDIX 6 Base-64 encoding scheme

The base-64 Content-Transfer-Encoding is designed to represent arbitrary sequences of octets in a form that need not be humanly readable. The encoding and decoding algorithms are simple, but the encoded data is consistently only about 33 percent larger than the unencoded data. This encoding is virtually identical to the one used in Privacy Enhanced Mail (PEM) applications, as defined in RFC 1421. The base-64 encoding is adapted from RFC 1421, with one change: base-64 eliminates the "*" mechanism for embedded clear text.

A 65-character subset of US-ASCII is used, enabling 6 bits to be represented per printable character. (The extra 65th character, "=", is used to signify a special processing function.)

NOTE: This subset has the important property that it is represented identically in all versions of ISO 646, including US ASCII and all characters in the subset are also represented identically in all versions of EBCDIC. Other popular encodings, such as the encoding used by the uuencode utility and the base-85 encoding specified as part of Level 2 PostScript, do not share these properties, and thus do not fulfill the portability requirements a binary transport encoding for mail must meet.

The encoding process represents 24-bit groups of input bits as output strings of 4 encoded characters. Proceeding from left to right, concatenating 3 8-bit input groups forms a 24-bit input group. These 24 bits are then treated as 4 concatenated 6-bit groups, each of which is translated into a single digit in the base-64 alphabet. When encoding a bit stream via the base-64 encoding, the bit stream must be presumed to be ordered with the most significant bit first. That is, the first bit in the stream will be the high-order bit in the first byte, and the eighth bit will be the low-order bit in the first byte, and so on.

Each 6-bit group is used as an index into an array of 64 printable characters. The character referenced by the index is placed in the output string. These characters, identified in Table C1, below, are selected so as to be universally representable, and the set excludes characters with particular significance to SMTP (e.g., ".", CR, LF) and to the encapsulation boundaries defined in this document (e.g., "-").

The output stream (encoded bytes) must be represented in lines of no more than 76 characters each. All line breaks or other characters not found in Table C1 must be ignored by decoding software. In base-64 data, characters other than those in Table C1, line breaks, and other white space probably indicate a transmission error, about which a warning message or even a message rejection might be appropriate under some circumstances.

Value / Encoding	Value / Encoding	Value / Encoding	Value / Encoding
0 / A	17 / R	34 / I	51 / z
1 / B	18 / S	35 / j	52 / 0
2 / C	19 / T	36 / k	53 / 1
3 / D	20 / U	37 / l	54 / 2
4 / E	21 / V	38 / m	55 / 3
5 / F	22 / W	39 / n	56 / 4
6 / G	23 / X	40 / o	57 / 5
7 / H	24 / Y	41 / p	58 / 6

Value / Encoding	Value / Encoding	Value / Encoding	Value / Encoding
8 / I	25 / Z	42 / q	59 / 7
9 / J	26 / a	43 / r	60 / 8
10 / K	27 / b	44 / s	61 / 9
11 / L	28 / c	45 / t	62 / +
12 / M	29 / d	46 / u	63 / /
13 / N	30 / e	47 / v	
14 / O	31 / f	48 / w	(pad) / =
15 / P	32 / g	49 / x	
16 / Q	33 / h	50 / y	

Special processing is performed if fewer than 24 bits are available at the end of the data being encoded. A full encoding quantum is always completed at the end of a body. When fewer than 24 input bits are available in an input group, zero bits are added (on the right) to form an integral number of 6-bit groups. Padding at the end of the data is performed using the '=' character. Since all base-64 input is an integral number of octets, only the following cases can arise: (1) the final quantum of encoding input is an integral multiple of 24 bits; here, the final unit of encoded output will be an integral multiple of 4 characters with no "=" padding, (2) the final quantum of encoding input is exactly 8 bits; here, the final unit of encoded output will be two characters followed by two "=" padding characters, or (3) the final quantum of encoding input is exactly 16 bits; here, the final unit of encoded output will be three characters followed by one "=" padding character.

Because it is used only for padding at the end of the data, the occurrence of any '=' characters may be taken as evidence that the end of the data has been reached (without truncation in transit). No such assurance is possible, however, when the number of octets transmitted was a multiple of three.

Any characters outside of the base-64 alphabet are to be ignored in base-64-encoded data. The same applies to any illegal sequence of characters in the base-64 encoding, such as "=====" .

Care must be taken to use the proper octets for line breaks if base-64 encoding is applied directly to text material that has not been converted to canonical form. In particular, text line breaks must be converted into CRLF sequences prior to base-64 encoding. The important thing to note is that this may be done directly by the encoder rather than in a prior cannibalization step in some implementations.

NOTE: There is no need to worry about quoting apparent encapsulation boundaries within base-64-encoded parts of multipart because no hyphen characters are used in the base-64 encoding.

APPENDIX 7 Grayscale Compression Codes

A7.1 Compression Codes

Compression	Value	Remarks
Wavelet Scalar Quantization Grayscale Fingerprint Image Compression Specification IAFIS-IC-0010(V3), dated December 19, 1997	WSQ	Algorithm to be used for the compression of grayscale images in Type-4, Type-7 and Type-13 to Type-15 records. Shall not be used for resolutions >500dpi.
JPEG 2000 [ISO 15444 / ITU T.800]	J2K	To be used for lossy and losslessly compression of grayscale images in Type-13 to Type-15 records. Strongly recommended for resolutions >500 dpi