M1- Finger Minutiae/Image Harmonization

Minutiae Placement and Type

For minutiae encoding compliant with ANSI INCITS 378-2004, determination of the placement (location and angular direction) of individual minutiae shall be determined according to section 5 of ANSI INCITS 378-2004.

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 Section 16.1.4.

Minutiae 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 Section 16.1.4.

M1 Minutiae Fields for the Type 9 logical record

Fields 9.001- 9.004

These first four fields are mandatory and retain the same meaning a described in Sections 16.2.1 through 16.2.4.

Field 9.121.   CBEFF Information

This mandatory 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.

Field 9.122.   Capture Equipment Identification

This mandatory 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.

Field 9.123.   Size of Scanned Image

This mandatory field shall contains the size of the original image. Two information items separated by the <US> character list the number of pixels in the in the x (horizontal) and y (vertical) directions of the original image. Each value is limited to 65,534 pixels.

Field 9.124.   Scanning Resolution

This mandatory field shall contains the x (horizontal) and y (vertical) resolutions used for scanning the original image. Two information items separated by the <US> character list the original scanning resolution in the x (horizontal) and y (vertical) directions. Each value is limited to 65,534 pixels.

Field 9.125.   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".

Field 9.126.   Finger Position (FGP)

This mandatory 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 6 shall be used to indicate the finger position.

Field 9.127.   Finger Quality

The mandatory field shall contain the quality of the overall finger minutiae 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 minutiae record.

Field 9.128.   Number of Minutiae

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

Field 9.129.   Finger Minutiae Data

The mandatory field has five 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 128.   The first and second information items are the 'x' coordinate and 'y' coordinates of the minutiae. The third information item is the minutiae angle recorded in units of two degrees. This value shall be nonnegative between 0 and 179. The fourth 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 final 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.

Additional M1-Based Fields for Type 14 Records

Field 14.025.   Size of Scanned Image

This mandatory field shall contain the size of the original image. Two information items separated by the <US> character list the number of pixels in the in the x (horizontal) and y (vertical) directions of the original image. Each value is limited to 65,534 pixels.

Field 14.026.   Scanning Resolution

This mandatory field shall contains the x (horizontal) and y (vertical) resolutions used for scanning the original image. Two information items separated by the <US> character list the original scanning resolution in the x (horizontal) and y (vertical) directions. Each value is limited to 65,534 pixels.

Field 14.027.   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".

Image Quality Score

14.024   Image Quality Score (IQS)

This ASCII field shall specify the quality score data for the finger image(s) stored in this record. Each subfield shall contain five information items to identify the finger number, 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 first information item is the finger number as chosen from Table 6 or 19. The second information item is a quantitative expression of the predicted matching performance of the biometric sample. This item contains the ASCII representation of a quality algorithm's score mapped to an integer image quality value between 1 and 100. Higher values indicate better quality. An entry of "-1" shall indicate a failed attempt to calculate a quality score. The third information item shall specify the alphanumeric ID value of the vendor of the quality algorithm used to calculate the quality score. NIST will maintain a Vendor Registry that will map the values in this field to registered quality algorithm vendors. The Vendor ID shall be composed of ASCII printable characters up to 16 characters in length. The fourth information item shall specify a numeric product code assigned by the vendor of the quality algorithm. 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. The final information item shall specify the version number of the quality algorithm used. The version number shall include a major number and minor number separated by a period. The major number and minor numbers should each be the ASCII representation of integer values in the range 0 to 255.

Each of the five information items shall be separated from the next by the <US> separator character. For the case of segmented slap images (Type 13-15), the subfield is repeated for each segmented finger image with the <RS> character separating the sets of finger image quality information items. For the case where more than one quality algorithm is used to evaluate the quality of the same finger, the subfield is repeated for each algorithm using the <RS> characters as the separator between quality algorithms. For the case where more than one quality algorithm is applied to a segmented slap image, the set of quality information items for each finger shall be listed for all fingers evaluated by the first algorithm, then for all fingers evaluated by the second algorithm, and so forth.

An example transaction for a quality score of 100 generated for the right index finger using a quality algorithm with a product code of 64530, version 001.123, by a vendor with a Vendor ID of "NIST" is:

"10.024:2 ^{US} 100 ^{US}NIST ^{US}64530 ^{US}001.123 ^{GS}".

<u>Segmented Finger Quality</u>

14.023   Segmented Finger Quality (SFQ)

This ASCII field shall be present if the captured image was the plain right or left four fingers or the combination of the left and right thumbs. It specifies the quality score data assigned by a finger image segmentation algorithm that is used to locate the individual fingers within a plain image. It provides a measure of estimated correctness regarding the accuracy of the location of the segmented finger within an image. For each segmented finger, this field shall contain five information items to identify the finger number, a quality score, and the algorithm used to create the quality score. This information is useful to enable the recipient of this segmentation score to differentiate between segmentation scores generated by different segmentation algorithms and adjust for any differences in processing or analysis as necessary.

The first information item is the finger number between one and ten as chosen from Table 6. The second information item is a quantitative prediction of the correctness of the determined offsets to a specific finger image. It contains the ASCII representation of the algorithm's score mapped to an integer image quality value between 1 and 100. Higher values indicate better quality.   An entry of "-1" shall indicate a failed attempt to calculate a score. The third information item shall specify the alphanumeric ID value of the vendor of the segmentation algorithm. NIST will maintain a Vendor Registry that will map the values in this field to registered quality algorithm vendors. The Vendor ID shall be composed of ASCII printable characters up to 16 characters in length. The fourth information item shall specify a numeric product code assigned by the vendor of the quality algorithm. 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. The final information item shall specify the version number of the quality algorithm used. The version number shall include a major number and minor number separated by a period. The major number and minor numbers should each be the ASCII representation of integer values in the range 0 to 255.

Each of the five information items shall be separated from the next by the <US> separator character. This subfield is repeated for each segmented finger whose coordinates appear in field 14.021. The <RS> character separates each set of five 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.

An example transaction for a quality score of 75 generated for each of the right four plain fingers using a segmentation algorithm with a product code of 64420, version 002.013, by a vendor with a Vendor ID of "NIST" is:

"10.023:2^{US}75^{US}NIST^{US}64420^{US}002.013^{RS}3^{US}75^{US}NIST^{US}64420^{US}002.013^{RS}4^{US}75^{US}NIST ^{US}64420 ^{US}002.013 ^{RS}5^{US}75^{US}NIST ^{US}64420 ^{US}002.013 ^{GS}"