



Overview of ANSI INCITS Fingerprint Standards on Data Interchange Format

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Agenda

BIOMETRICS
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- ▶ Biometric Standards
- ▶ ANSI INCITS Fingerprint Standards vs. SC 37 Fingerprint Standards
- ▶ ANSI INCITS 381-2004 Finger Image-Based Data Interchange Format
- ▶ ANSI INCITS 378-2004 Finger Minutiae Format For Data Interchange
- ▶ ANSI INCITS 377-2004 Finger Pattern Data Interchange Format



Biometric Standards (1/2)



Approved Data Interchange Formats

- ▶ ANSI INCITS 377-2004
Finger Pattern Data Interchange Format
- ▶ ANSI INCITS 378-2004
Finger Minutiae Format For Data Interchange
- ▶ ANSI INCITS 379-2004
Iris Image Interchange Format
- ▶ ANSI INCITS 381-2004
Finger Image-Based Data Interchange Format
- ▶ ANSI INCITS 385-2004
Face Recognition Format For Data Interchange
- ▶ ANSI INCITS 396-2005
Hand Geometry Interchange Format
- ▶ ISO/IEC 19794-2 Biometric Data Interchange Format - Part 2: Finger Minutiae Data
- ▶ ISO/IEC 19794-4 Biometric Data Interchange Format - Part 4: Finger Image Data
- ▶ ISO/IEC 19794-5 Biometric Data Interchange Format - Part 5: Face Image Data
- ▶ ISO/IEC 19794-6 Biometric Data Interchange Format - Part 6: Iris Image Data



Biometric Standards (2/2)



Conformance Testing Methodologies for the Data Interchange Formats

(Under development)

- ▶ Generalized Testing Methodology – Part 1
- ▶ Conformance Testing Methodology for INCITS 377
- ▶ Conformance Testing Methodology for INCITS 378
- ▶ Conformance Testing Methodology for INCITS 379
- ▶ Conformance Testing Methodology for INCITS 381
- ▶ Conformance Testing Methodology for INCITS 385

Other Data Interchange Formats and Related Standards

(Under development)

- ▶ INCITS 395
Signature/Sign Data
- ▶ Biometric Sample Quality



ANSI INCITS Fingerprint Standards vs. SC 37 Fingerprint Standards



ANSI INCITS Fingerprint Standards	SC 37 Fingerprint Standards
INCITS 378 Finger Minutiae Format For Data Interchange	Biometric Data Interchange Format – Part 2, Finger Minutiae Data (Approved July 2005)
INCITS 381 Finger Image-Based Data Format Interchange	Biometric Data Interchange Format – Part 4, Finger Image Data (Approved July 2005)
INCITS 377 Finger Pattern Data Interchange Format	Biometric Data Interchange Format – Part 3, Finger Pattern Spectral Data (FCD)
	Biometric Data Interchange Format – Part 8, Finger Pattern Skeletal Data (CD)

FCD: Final Committee Drafts

CD: Committee Drafts



ANSI INCITS 381-2004

Finger Image-Based Data Interchange Format



Description

- ▶ The Finger Image-Based Interchange Format is applicable to biometric applications requiring exchange of raw or processed fingerprint images that may not be limited by the amount of resources required for data storage or transmission time.
- ▶ This standard defines the content, format and units of measurement for the exchange of finger image data that may be used in the verification or identification process of a subject.



Structure of Finger Image Data Format

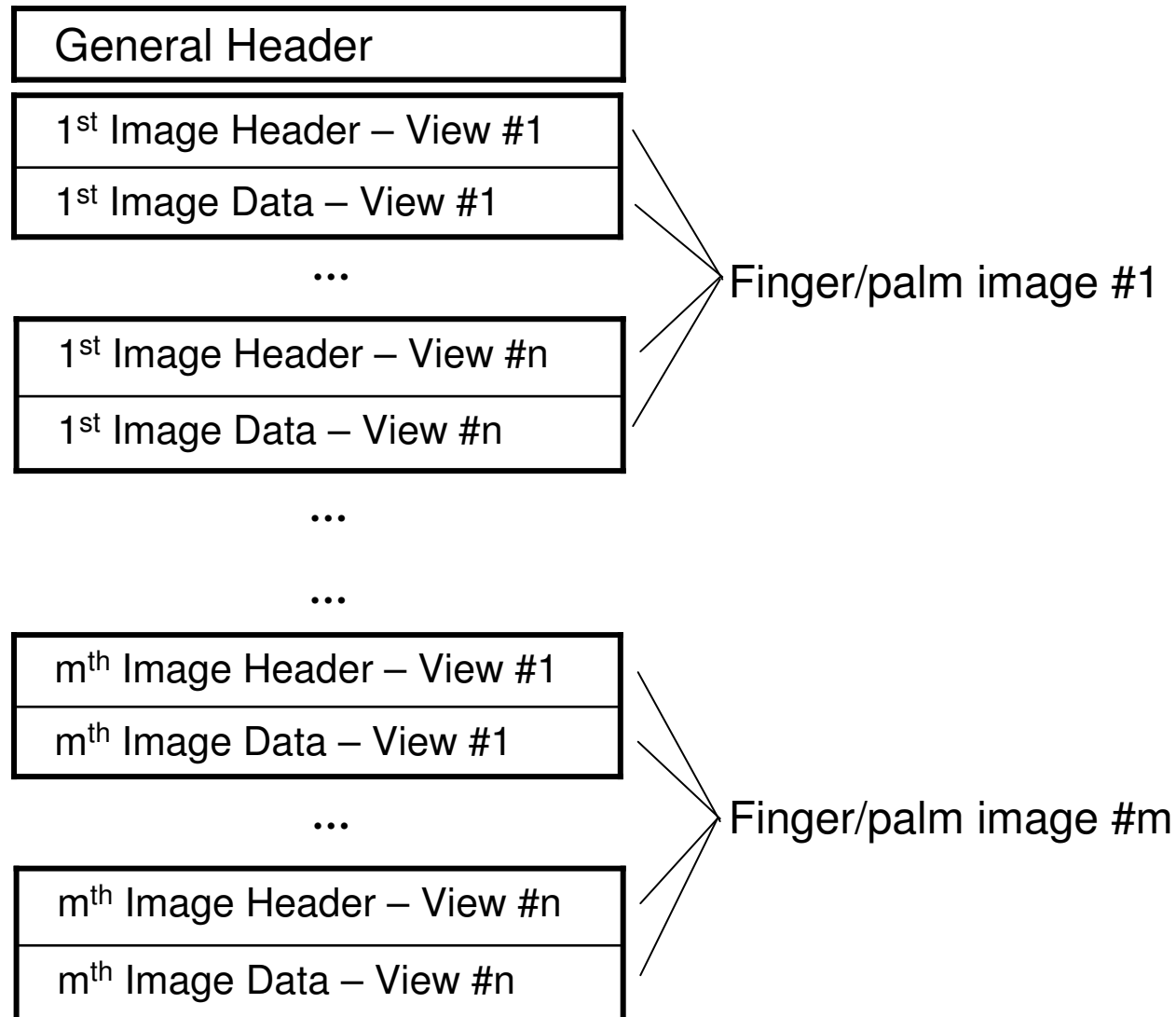




Image Acquisition Setting

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

Setting level: The level at which all of the minimum acquisition parameters were satisfied during the capture of the image.

Scan resolution: The number of pixels per unit distance used by a sensor or scanning device to initially capture a fingerprint or palmprint image.

Pixel depth: The number of bits per each pixel (single picture element).

Dynamic range: The number of gray levels per each image.

ppcm: Pixels per centimeter.

ppi: Pixels per inch.

Certification: Indicates compliance with established certification procedures. EFTS/F indicates compliance to Appendix F of the FBI's Electronic Fingerprint Transmission Specification.



Fields of Finger Image Data Format



General Header

Format identifier	4
Version number	4
Record length	6
CBEFF Product Identifier	4
Scanner ID	2
Number of fingers/palms	1
Scan resolution (horiz)	2
Scan resolution (vert)	2
Image resolution (horiz)	2
Image resolution (vert)	2
Pixel depth	2
Image compression algorithm	1
Reserved	4

Finger/palm Image Header and Data

Length of finger data block	4
Finger/palm position	1
Count of views	1
View number	1
Finger/palm image quality	1
Impression type	1
Horizontal line length	2
Vertical line length	2
Reserved	1
Finger/palm image data	Var



INCITS 381-2004 vs. ISO/IEC 19794-4 (Differences)



General Record Header		
Field	ANSI INCITS 381-2004	ISO/IEC FDIS 19794-4*
CBEFF Product Identifier	4 bytes	Not specified

Header block size

36 bytes

32 bytes

Finger Image Header Record		
Field	ANSI INCITS 381-2004	ISO/IEC FDIS 19794-4*
Finger/palm image quality	1 byte (Undefined**)	1 byte (BioAPI specification)

* Final Draft International Standard Text for ISO/IEC 19794-4, Information Technology – Biometric data interchange formats – Part 4: Finger image data (2004-12-08)

** Finger/palm image quality (section 7.2.5) – This reserved field shall eventually contain an image quality metric for the scanned finger/palm images. Until standard methods are developed for computing a meaningful image quality metric, this field shall contain the number “254” to indicate an undefined quality measure.



ANSI INCITS 378-2004

Finger Minutiae Format for Data Interchange



Description

- ▶ The Finger Minutiae Format for Data Interchange standard specifies a method of creating biometric templates of fingerprint minutiae, such as ridge endings and bifurcations.
- ▶ The specification provides values for:
 - Finger position codes
 - Finger impression-type code (plain up/down or rolled)
 - Ridge counts
 - “Core” (approximate center of a fingerprint image data)
 - “Delta” (point of divergence of a ridge) values, etc.



Structure of Minutia Data Format



Record Header
1 st Finger Header
1 st Finger – View #1 – 1 st Minutia Record
...
1 st Finger – View #1 – Last Minutia Record
1 st Finger – View #1 – 1 st Extended Data (optional)
...
1 st Finger – View #1 – Last Extended Data (optional)
...
1 st Finger – View #n – 1 st Minutia Record
...
1 st Finger – View #n – Last Minutia Record
1 st Finger – View #n – 1 st Extended Data (optional)
...
1 st Finger – View #n – Last Extended Data (optional)
2 nd Finger, ..., Last Finger

All minutia records contain the extended data block length. This field signifies the existence of extended data.

Extended data area includes ridge count data, core and delta data, and vendor-defined extended data.



An Example of Finger Minutia





Fields of Finger Minutia Data - 1/3



Record Header

Format identifier	4
Version number	4
Record length	2 or 6
CBEFF Product Identifier	4
Capture Equip. compliance	4 bits
Capture Equip. ID	12 bits
Image size in X	2
Image size in Y	2
X (horizontal) resolution	2
Y (vertical) resolution	2
Number of Finger Views	1
Reserved	1

Single Finger View Minutiae Record

Finger Position	1
View #	4 bits
Impression Type	4 bits
Finger quality	1
Finger Minutia data	Var
Extended data	Var



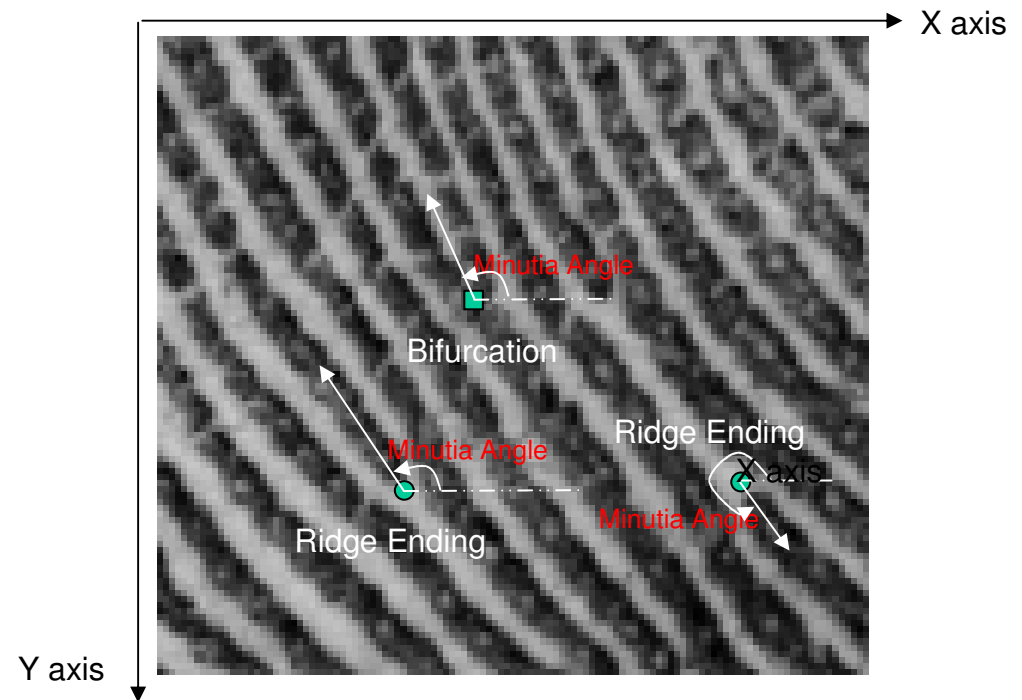
Fields of Finger Minutia Data - 2/3

Finger Minutiae Data

Type	2 bits
X coordinate	14 bits
Reserved	2 bits
Y coordinate	14 bits
Minutia Angle	1
Minutia Quality	1

Extended Data

Block Length	2
Type ID code	2
Data Length	2
Data	Var





Fields of Finger Minutia Data - 3/3

Each extended data area may contain vendor-specific data, or one of following:

Ridge count data	Size	Valid Values
Ridge count extraction method	1 byte	0 to 2
Ridge count data – index #1	1 byte	1 to # of minutiae
Ridge count data – index #2	1 byte	1 to # of minutiae
Ridge count data – count	1 byte	Var
<i>additional ridge counts...</i>		

Core and delta data	Valid Values
Core information type	0 to 1
Number of cores	0 to 15
X location	Var
Y location	Var
Angle (if core info type not equal to 0)	0 to 179
Delta information type	0 to 1
Number of deltas	0 to 15
X location	Var
Y location	Var
Angle (if delta info type not equal to 0)	0 to 179



Examples of Extended Data Area – Ridge Count Data (Data Type code = 1)



Extraction method: 1 – Four-neighbor (Quadrants)

Center minutiae: #5

Ridge Count Data: $1 + 4 \times 3 = 13$ bytes

Data*: 1 5 1 2 5 3 4 5 5 0 5 6 1

*The ridge count data shall be listed in increasing order of the index numbers. (Section 6.6.2.2)

Quadrant	Minutiae #1	Minutiae #2	Ridge Count
1	5	3	4
2	5	1	2
3	5	5	0
4	5	6	1

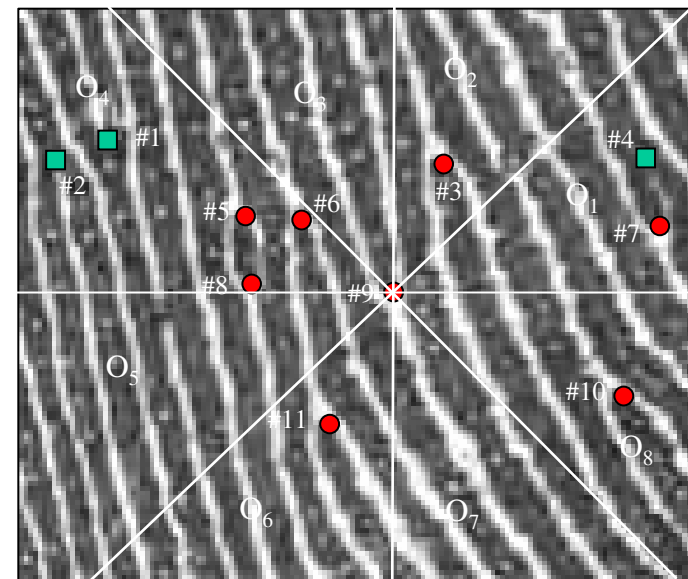
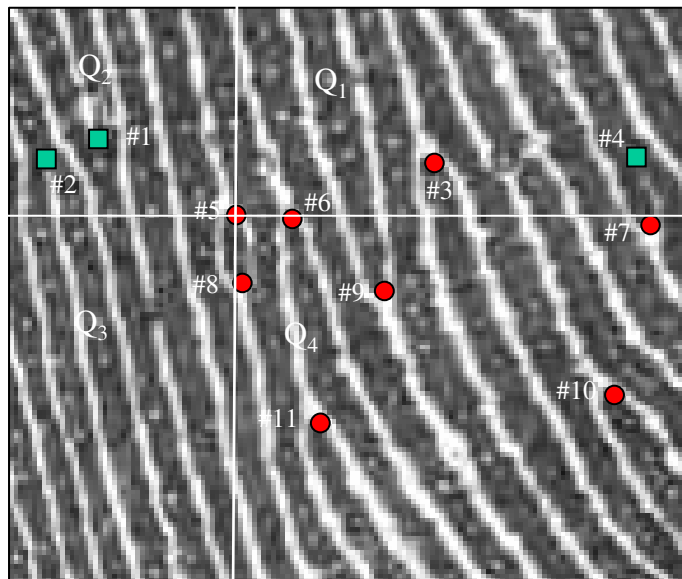
Extraction method: 2 – Eight-neighbor (Octants)

Center minutiae: #9

Ridge Count Data: $1 + 8 \times 3 = 25$ bytes

Data*: 2 9 3 1 9 6 1 9 7 5 9 9 0 9 9 0 9 9 0 9 10 3 9 11 2

Octant	Minutiae #1	Minutiae #2	Ridge Count
1	9	7	5
2	9	3	1
3	9	9	0
4	9	6	1
-	9	-	-
8	9	10	3





Example of Extended Data Area – Core and Delta Data (Data Type code = 2)



Core Data

Type: 0 – has no angular information

Number of Cores: 1

Location: X: 408, Y: 307

Core Data: $(1 + 2 + 2 = 5 \text{ bytes})$

Data: 1 408 307

Delta Data

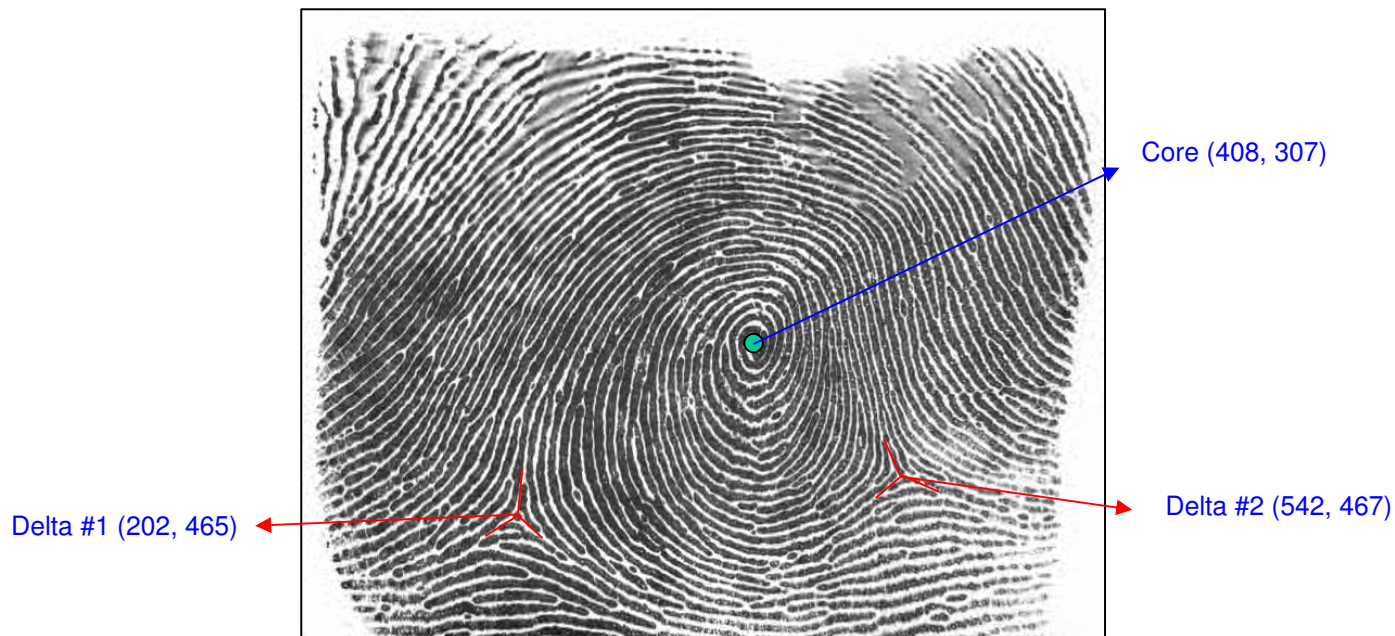
Type: 0 – has no angular information

Number of Deltas: 2

Locations: X: 202, Y: 465 and X: 542, Y: 467

Delta Data: $(1 + 2 + 2 + 2 + 2 = 9 \text{ bytes})$

Data: 2 202 465 542 467





INCITS 378-2004 vs. ISO/IEC 19794-2 (Differences)



Record Header		
Field	ANSI/INCITS 378 - 2004	ISO/IEC FDIS 19794-2*
Length of Record	2 or 6 bytes (2 bytes for less than 65,536)	4 bytes
CBEFF Product Identifier	4 bytes	Not specified
Capture Equipment	4 bits (Capture Equipment Compliance)	4 bits (Capture Equipment Certification)

Finger View Header		
Field	ANSI/INCITS 378 - 2004	ISO/IEC FDIS 19794-2*
Finger position	0 – 14	0 – 10 (Not including Plain codes)
θ: Angle	0 – 179 (Resolution is 2 degrees)	0 – 255 (Resolution is 1.40625 degrees)

Extended Data (Optional Information)		
Field	ANSI/INCITS 378 - 2004	ISO/IEC FIDS 19794-2*
Core information type and No. of Cores	Core information type go first	No. of Cores go first
Delta information type and No. of Deltas	Delta information type go first	No. of Deltas go first
Zonal Quality Data - Cell Width	Not specified	1 – 255
Cell Height	Not specified	1 – 255
Cell Information Bit Depth	Not specified	1 – 255
Cell Quality Data	Not specified	Var.

* Final Draft International Standard Text for ISO/IEC 19794-2, Information Technology – Biometric data interchange formats – Part 2: Finger minutiae data (2005-01-06)



ANSI INCITS 377-2004

Finger Pattern Data Interchange Format



Description

- ▶ The Finger Pattern Based Interchange Format standard specifies a method of creating biometric templates of fingerprint biometric information using ridge pattern measurements found in fingerprints.



Structure of Pattern Data Format

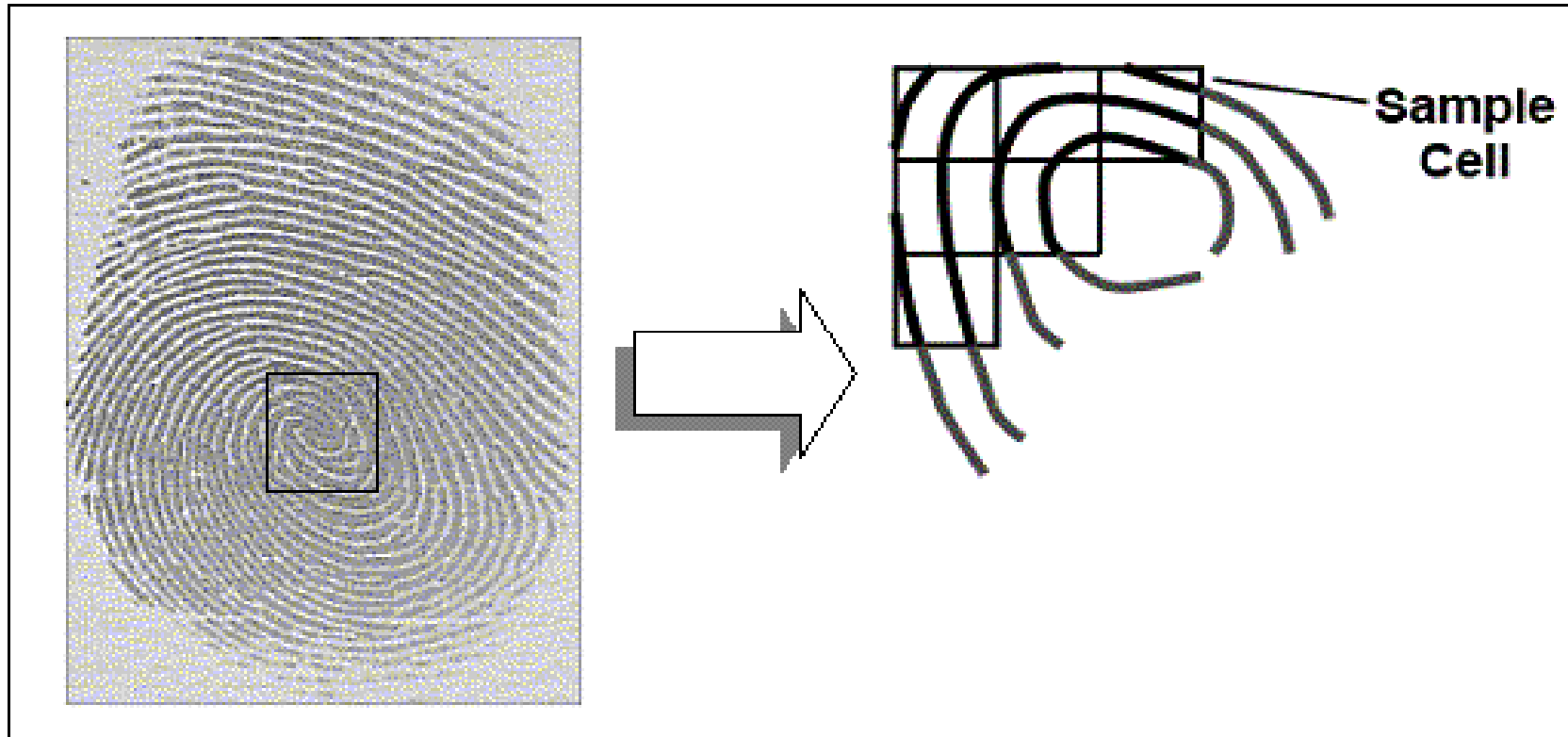


Record Header
Finger Pattern #1 - Record Header
Finger Pattern #1 - Data – 1 st View
Finger Pattern #1 - Extended Data – 1 st View
...
Finger Pattern #1 - Data – Last View
Finger Pattern #1 - Extended Data – Last View
...
Finger Pattern #n - Record Header
Finger Pattern #n - Data – 1 st View
Finger Pattern #n - Extended Data – 1 st View
...
Finger Pattern #n - Data – Last View
Finger Pattern #n - Extended Data – Last View

This Extended Data block of the record is reserved for any proprietary data used by the System Vendor.



Finger Pattern – 1/2

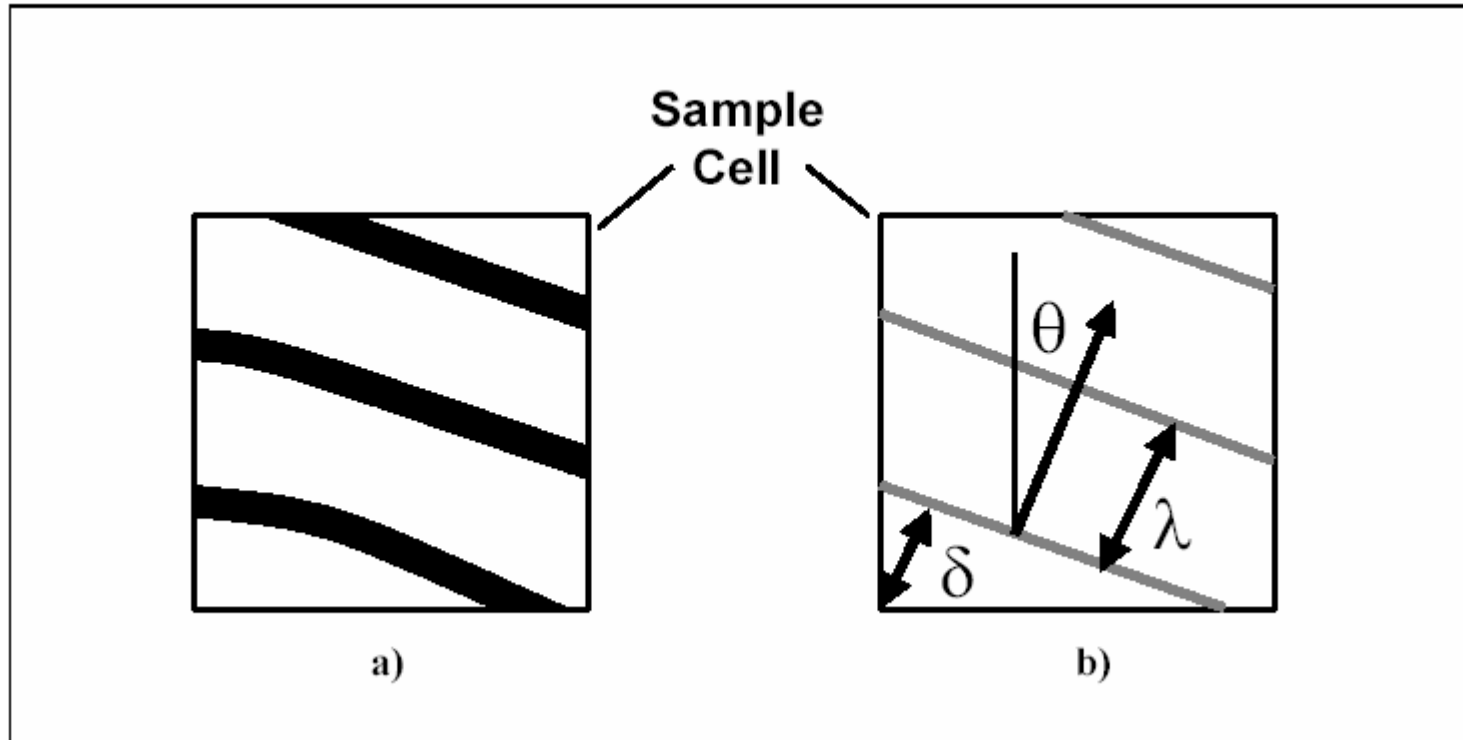


The standard specifies a method of creating biometric templates of fingerprint biometric information using ridge pattern measurements found in fingerprints.

The image is reduced and then grouped into sample cells—each cell is 5x5 pixels. The sample cells are then analyzed individually.



Finger Pattern – 2/2



θ : 0 to 180 degrees (where 0 degrees is defined as parallel to the y, or vertical, axis, and a positive increase of θ corresponds to a clockwise rotation.)

λ : 0 to Maximal Spatial Frequency, which refers to the (spatial) frequency at which exactly two samples of an image span a complete period of a (co)sinusoidal pattern.

δ : 0 to 360 degrees (where 0 degrees corresponds to a ridge being coincident with the origin of a cell.)



Fields of Finger Pattern Data - 1/2



Record Header

Format identifier	4
Version number	4
Length of record	4
CBEFF Product Identifier	4
Number of Finger Patterns	1
Size of finger pattern in X-direction	1
Size of finger pattern in Y-direction	1
Resolution in x-direction	2
Resolution in y-direction	2
Number of Cells in X-direction	1
Number of Cells in Y-direction	1
Number of Pixels in Cells in X	1

Number of Pixels in Cells in Y	1
Cellular X-offset	1
Cellular Y-offset	1
Bit-depth of Cell structure Angle	1
Bit-depth of Cell structure Wavelength	1
Bit-depth of Cell structure Phase Offset	1
Bit-depth of Cell structure quality	1
Cell quality granularity	1
Reserved	2



Fields of Finger Pattern Data - 2/2

Finger Pattern Record Header

Finger location	1
Impression type	1
Number of Views	1
Fingerprint pattern quality	1
Length of data block	2

Finger Pattern Data

View number	1
Finger pattern cell data	Var
Cell quality data	Var
Pattern extended data	Var



INCITS 377-2004 vs. ISO/IEC 19794-3 (Differences)



Definitions of Parameters		
Parameters	ANSI/INCITS 377-2004	ISO/IEC FDIS 19794-3*
θ (0 – 180)	0 degree is defined as parallel to the Y	0 degree is defined as parallel to the X
λ	0 to Maximal Spatial Frequency	Minimal Spatial Wavelength to Infinite

Record Header		
Field	ANSI/INCITS 377-2004	ISO/IEC FIDS 19794-3*
CBEFF Product Identifier (PID)	4 bytes	Not specified
Size of finger pattern in X-direction (pixels)	1 byte	Not specified
Size of finger pattern in Y-direction (pixels)	1 byte	Not specified
Number of Pixels between Cell Centers in X-direction	Not specified	1 byte
Number of Pixels between Cell Centers in Y-direction	Not specified	1 byte
Spectral Component Selection Method	Not specified	1 byte
Type of Window	Not specified	1 byte
Standard Deviation	Not specified	4 bytes
Number of Frequencies	Not specified	2 bytes
Frequencies	Not specified	4 x No. of Frequencies
Number of Orientations	Not specified	1 byte
Number of Spectral Components to be Retained per cell	Not specified	6 bytes

* Final Draft International Standard Text for ISO/IEC 19794-3, Information Technology – Biometric data interchange formats – Part 2: Finger Pattern Spectral data (2005-01-04)



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