Overview of ANSI INCITS Biometric Standards on Data Interchange Format

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Director's Introduction

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Standards Development is a high priority of DoD Biometrics. In this briefing, Robert Yen, one of DoD's leading subject matter experts, reviews recently approved ANSI INCITS Biometric Standards for Data Interchange Formats.

This briefing contains extensive technical information on this topic that will help educate members of the DoD community as well as others interested in biometric standards development.

Thank you for your interest in DoD Biometrics.

John Woodward, Jr,
Director
DoD Biometrics Management Office

ANSI INCITS Biometric Standards

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- Recently Approved Data Interchange Format Standards
  - ANSI INCITS 377-2004: Finger Pattern Data Interchange Format – approved January 2004
  - ANSI INCITS 378-2004: Finger Minutiae Format for Data Interchange – approved February 2004
  - ANSI INCITS 379-2004: Iris Image Interchange Format – approved May 2004
  - ANSI INCITS 381-2004: Finger Image-Based Data Interchange Format – approved May 2004
  - ANSI INCITS 385-2004: Face Recognition Format for Data Interchange – approved May 2004

  Note: ANSI INCITS is the U.S. body for biometrics standards development
- Approval of these standards will help further interoperable biometric exchanges within DoD and with other USG Organizations
- Standards under development: Hand Geometry and Signature/Sign

ANSI INCITS 377-2004
Finger Pattern Data Interchange Format

Description

- The Finger Pattern 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

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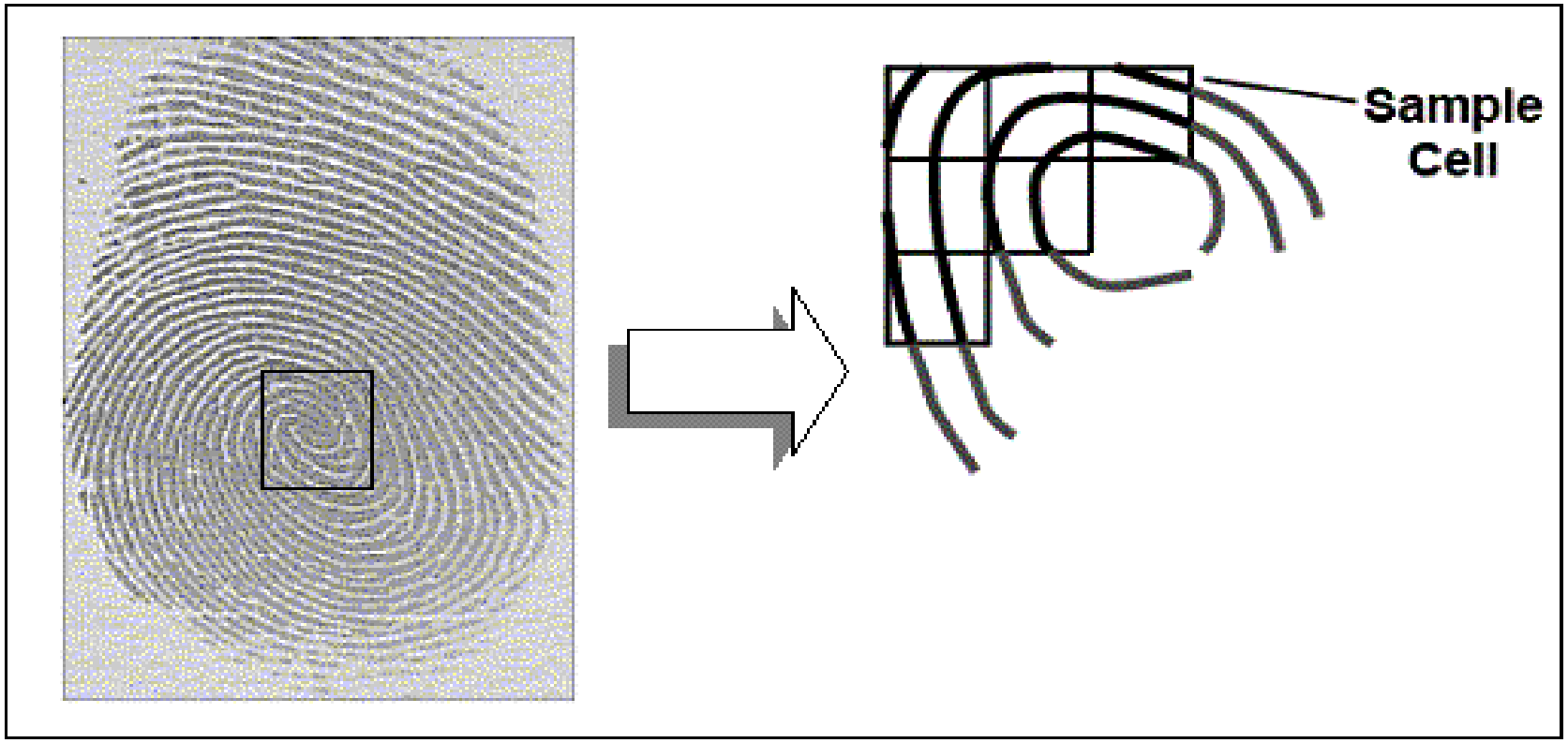
Record Header
Finger Pattern #1 - Record Header
Finger Pattern #1 - Data – 1st View
Finger Pattern #1 - Extended Data – 1st View
…
Finger Pattern #1 – Data – Last View
Finger Pattern #1 – Extended Data – Last View
…
Finger Pattern #n - Record Header
Finger Pattern #n – Data – 1st View
Finger Pattern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

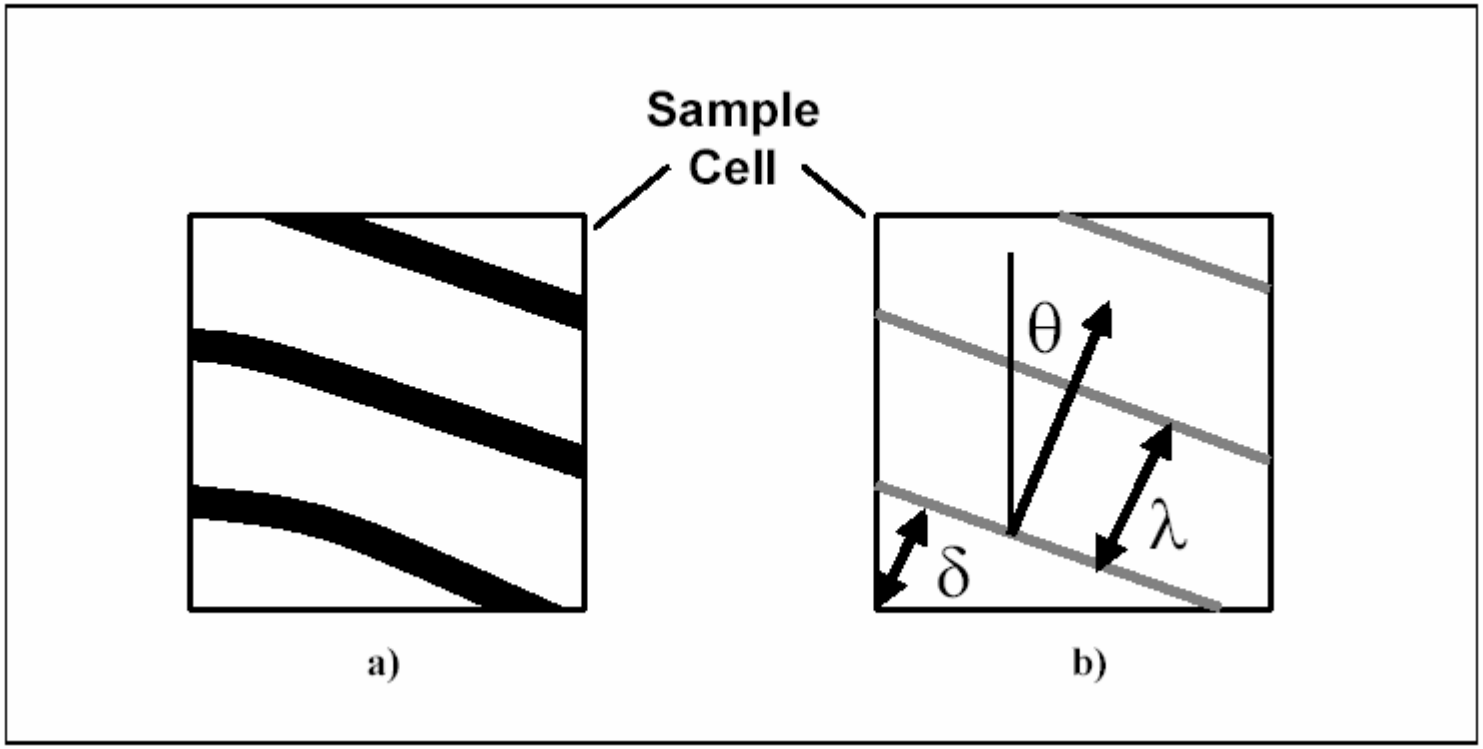
Finger Pattern – 1/2



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

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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 Minutiae Data - 2/2

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Finger Minutiae Data

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

Common Extended Data

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

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)
  - “Delta” (point of divergence of a ridge) values, etc.

Structure of Minutiae Data Format

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

All minutiae 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 Minutiae

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Fields of Finger Minutiae Data - 1/2

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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 minutiae data	Var
Extended data	Var

Fields of Finger Minutiae Data - 2/2

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Finger Minutiae Data

Type	2 bits
X coordinate	14 bits
Reserved	2 bits
Y coordinate	14 bits
Minutiae angle	1
Minutiae quality	1

Common Extended Data

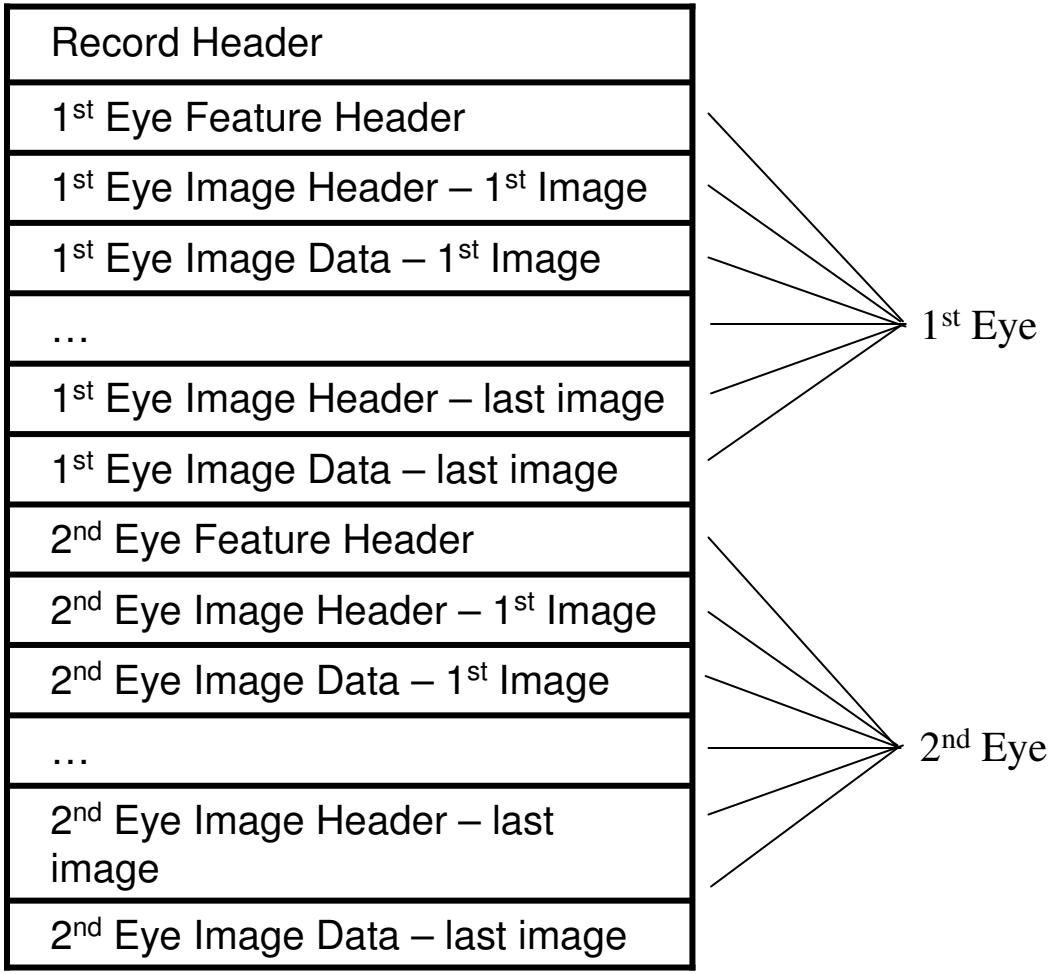
Block length	2
Type ID code	2
Data length	2
Data	Var

ANSI INCITS 379-2004
Iris Image Interchange Format

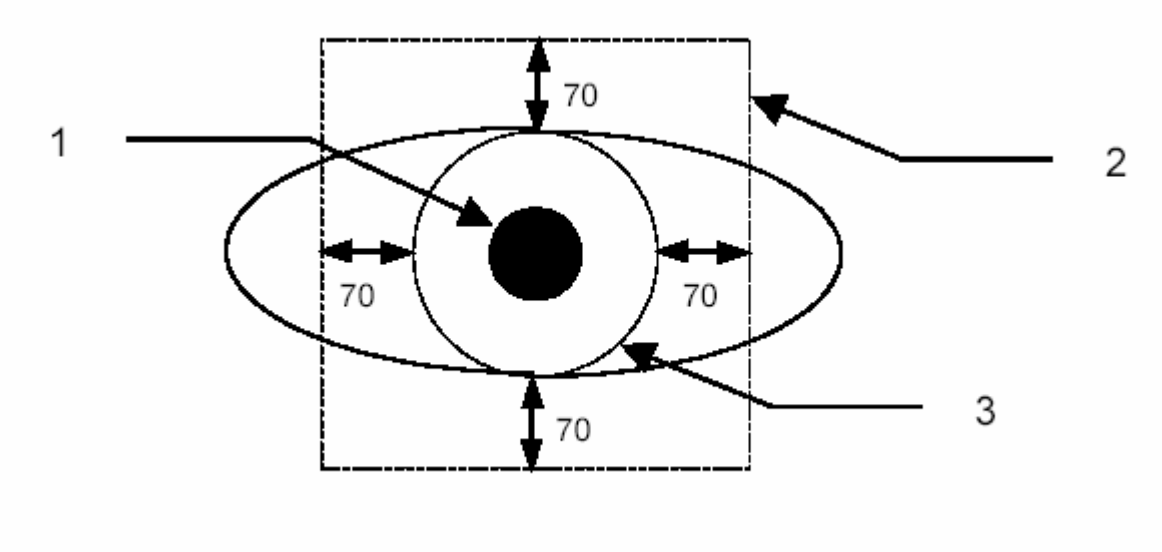
Description

- The Iris Image Data Interchange Format standard specifies a method of creating biometric images from iris characteristics.
- This specification addresses such topics as image compression, image preprocessing, image data packet formats, and image header formats.

Structure of Iris Data Format



Key Features – Iris Image



The standards identifies three “points of interest” in an iris image:

(1) The pupil boundary,

(2) The image border, and

(3) The iris boundary.

The number “70” denotes that 70 pixels of image data are required by the specification to center the iris data from the image border.

Fields of Iris Data

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Record Header

Format ID	4
Version	4
Record length	4
CBEFF product ID	4
Capture device ID	2
No. of iris features	1
Record header length	2
Iris image properties bitfield	2
Iris diameter	2
Image format	2
Raw image width	2
Raw image height	2
Intensity depth	1
Image transformation	1

Record Header - continued

Device unique identifier	6
GUID	16

Iris Feature Header

Feature identifier	1
No. of images	2

Iris Image Header and Data

Image number	2
Quality	1
Rotation angle of eye	2
Rotation uncertainty	2
Image length	4
Image data	Var

ANSI INCITS 381-2004
Finger Image-Based Data Interchange Format

Description

- The Finger Image-Based Interchange Format applies to biometric applications requiring exchanges of raw or processed fingerprint images that may be less constrained to storage and/or transmission time limitations.
- This standard defines the content, formats, 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

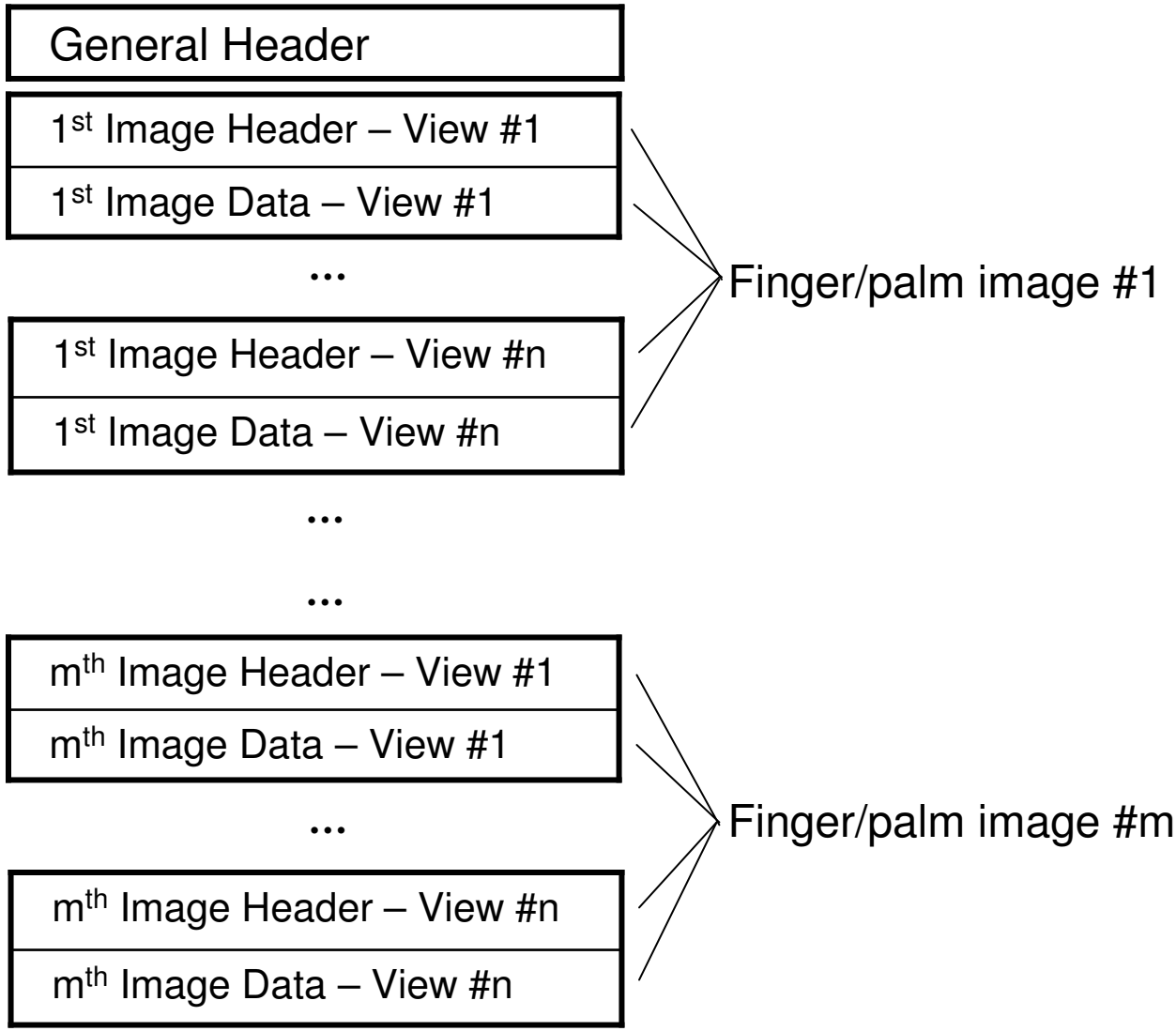

Image Acquisition Setting

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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.

Certification: Indicates compliance with established certification procedures. Image acquisition settings complaint with Appendix F of the FBI's Electronic Fingerprint Transmission Specification are denoted as "EFTS/F".

Fields of Finger Image Data Format

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General Header

Format identifier	4
Version number	4
Record length	6
CBEFF product identifier	4
Scanner ID	2
Number of finger/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

ANSI INCITS 385-2004
Face Recognition Format for Data Interchange

Description

- The Face Recognition Format for Data Interchange specifies a method of creating biometric images from facial characteristics.
- This standard specifies image dimensions (e.g., position of eyes and relative length of the head in an image), image resolution and focus, image colors, and the representation of characteristics (e.g., pixels, gray scales, byte order, data structures, etc.).

Structure of Facial Data Format

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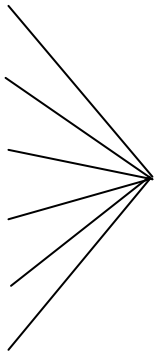
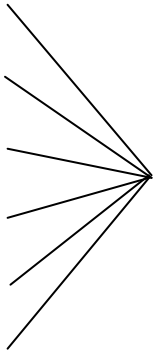
CBEFF Header
Facial Header
Face #1 - Facial Information
Face #1 1st Feature Point Data
…
Face #1 Last Feature Point Data
Face #1 Image Information
Face #1 Image Data
…
Face #n Facial Information
Face #n 1st Feature Point Data
…
Face #n Last Feature Point Data
Face #n Image Information
Face #n Image Data
CBEFF Signature

CBEFF: Common Biometric Exchange Formats Framework



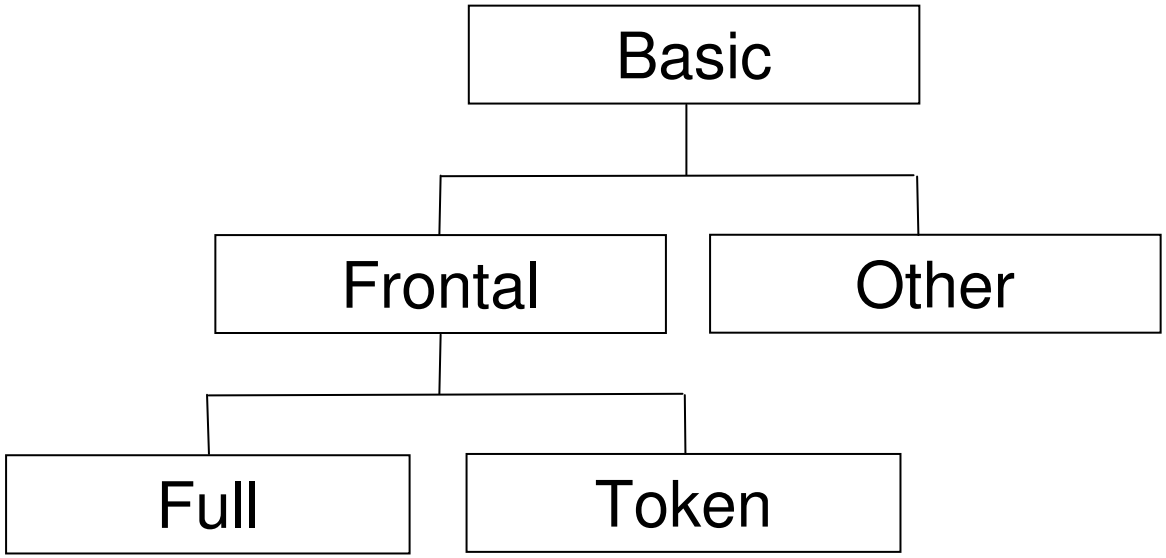
Face #1



Face #n

Facial Image Types

All child types inherit the properties of their parent type.



Basic: The basic face image type.

Frontal: Includes all frontal facial images (as opposed to profile, which would fall under Other). Shoulders are square to camera.

Full: Includes full face as well as the outline of the shoulders.

Token: Includes just the full face.

Other: All non-frontal images fall under this type.

Fields of Facial Data – 1/2

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CBEFF Header

CBEFF format owner	2
Format type	2

Facial Header

Format identifier	4
Version number	4
Length of record	4
Number of faces	2

CBEFF: Common Biometric Exchange Formats Framework

Fields of Facial Data – 2/2

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Facial Data - Information

Face image block length	4
Number of feature points	2
Gender	1
Eye color	1
Hair color	1
Feature mask	3
Expression	2
Pose angle	3
Pose angle uncertainty	3

Facial Data – Feature Point(s) - optional

Feature type	1
Feature point	1
Horizontal position	2
Vertical position	2
Reserved	2

Facial Data – Image Information

Face image type	1
Image data type	1
Width	2
Height	2
Image color space	1
Source type	1
Device type	1
Quality	2
Image data	Var

CBEFF Signature

Summary

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- This briefing presents an overview of five recently approved ANSI INCITS Biometric Standards for Data Interchange Formats.
- This briefing contains extensive technically information that will help educate the national security community as well as other entities interested in the development of biometric standards.
- Approval of these standards and their subsequent implementation is a major step forward in enabling interoperable biometric data exchanges within DoD and with other USG agencies
- In support of the 02 February 2004 memorandum entitled "Department of Defense (DoD) Compliance with the Internationally Accepted Standard for Electronic Transmission and Storage of Fingerprint Data from 'Red Force' Personnel," DoD should actively contribute to development of the new version of Data Format for the Interchange of Fingerprint, Facial, & Scar Mark & Tattoo (SMT) Information standard to ensure that it fully conforms with the five standards described in this briefing.

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