## Biometric Data Interchange Standards and ICAO 9303 Relevance

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Steinbeis-Transferzentrum BISE – Biometrie





## Data Interchange Standards

### Agenda

- Transition of ISO/IEC 19794-x to 39794-x
- Fingerprint Sample Quality
- Face Sample Quality

### Transition from 19794 to 39794

## **First Generation Format Standards**



The 19794-Family: Biometric data interchange formats

## Generation 2 of ISO/IEC 19794



#### the semantic is equivalent for binary encoded and XML encoded parts

**Christoph Busch** 

## Part 6: Iris image data

### ISO/IEC 19794-6:2011



- 4 new iris image formats, compressible to as little as 2,000 bytes
- Iris formats are now highly empirically based, thanks to NIST IREX testing results
- Recommended target record sizes for different applications
- Recommended compression for different applications
- Formats differ in their required amount of image pre-processing
- Original 19794-6:2005 raw image format retained as one case

## Part 6: Iris image data

### One new data format in 19794-6:2011

• highly compact iris image, compressed to 2,000 bytes



Source: ISO/IEC 19794-6

- Cropping, and masking non-iris regions, preserves the coding budget
- Pixels outside the ROI fixed to constant values, for normal segmentation
- Softening the mask boundaries also preserves the coding budget
- Interoperability of this vendor-neutral format confirmed by IREX results
- At only 2,000 bytes, iris images are now much more compact than fingerprints

## Generation 3: ISO/IEC 39794



### Generation 3:

- The common semantics amongst all parts continue to form the Framework of Generation 3
- All parts exist in ASN.1 and XML encoding with a (revised) harmonized semantic
- PAD data will be encoded

## ICAO 9303 Data Group Details

Data stored on the chip (LDS)

- DG1: Information printed on the data page
- DG2: Facial image of the holder (mandatory)
- DG3: Fingerprint image of left and right index finger
- DG4: Iris image (not in the EU)
- DG15: Active Authentication Public Key Info
- DG16: Persons to notify

**Document Security Object** 

Hash values of DGs



Source: ICAO 9303 Part 10, 2015

. . . .

## Transition from 19794-x to 39794-x

### Biometric Data to be stored

- Framework: ISO/IEC 19794-1:2005
- Finger image data: ISO/IEC 19794-4:2005
- Face image data: ISO/IEC 19794-5:2005
- Framework: ISO/IEC 39794-1:2019 https://www.iso.org/standard/70788.html
- Finger image data: ISO/IEC 39794-4:2019 https://www.iso.org/standard/72156.html
- Face image data: ISO/IEC 39794-5:2019 https://www.iso.org/standard/72155.html
- Transition schedule
  - ICAO has adopted its 9303 specification in 2020 and refers now to ISO/IEC 39794 and its Parts 1, 4 and 5.
  - Passport reader equipment must be able to handle ISO/IEC 39794 data by 2025-01-01 (5 years preparation period).
  - Between 2025 and 2030, passport issuers can use the old version or the new version of standards (5 years transition period).





## Transition from 19794-x to 39794-x

### Agreed between ICAO/SC17WG3 and SC37WG3

- The encoding of G3 should be FORWARD compatible, such that G3 readers can parse G3+ passports with extended data structure as long as the respective G3+ data structure contains at least the image data in the format that was defined in G3.
  - Thus anticipate future new fields.
- The encoding of G3 should allow a trans-codable TLV-BIN record, that is at most marginally larger than a G1 binary record
- The design of the G3 should minimize the increase of the read-out time for a passport reader.
- G3 encoded records (XML or TLV) must be trans-codable within the Generation

## FORWARD compatibility in 39794

### Defined between ICAO/SC17WG3 and SC37WG3

- "A parser must also be able to read data records, Jan 2014 which are based on newer standards as the parser itself, and understand data items which existed in older or equal standards of the parser.
  - All newer data item shall not disturb the parsing process and shall be ignored.
  - Newer standards must at least include the mandatory data items of the previous standards."
- Example:
  - In order to be forward compatible, a G3 e-passport reader would need to be able to read the G3+ data fields that are maintained in records of later generations

## **Extensibility of Binary Data Formats**

Extensibility of Binary Data Formats Achieved using

- Extensible specifications in ASN.1 (Abstract Syntax Notation One) [ISO/IEC 8824-1]
- Distinguished Encoding Rules of ASN.1 [ISO/IEC 8825-1]

Extension of ASN.1 modules:

- First versions of ASN.1 modules contain extension markers »...« at places where additional components may be added.
- If the format needs to be extended, add additional components after an extension marker

ASN.1 modules from ISO/IEC 39794 are available for download from

• https://standards.iso.org/iso-iec/39794

List of tools for processing ASN.1 modules:

• https://www.itu.int/en/ITU-T/asn1/Pages/Tools.aspx

## Extensibility of XML Formats

- Based on XSDs (XML schema definitions)
- Extension of XSDs:
  - XSDs contain

<xs:any namespace="##other" processContents= "lax" minOccurs="0"/>
at places where future extensions are expected.

- If the format needs to be extended,
  - Define a new XSD with an own namespace
  - Import the base XSD as is
  - Redefine the base types to be extended by adding new elements
- XSDs from ISO/IEC 39794 are available for download from
  - https://standards.iso.org/iso-iec/39794/
- List of tools for working with XML documents and XML schema definitions:
  - https://www.w3.org/XML/Schema.html#Tools

## Extensibility Biometric Data Block

### **Basic Structure**



## Abstract Syntax in ASN.1

### **Basic Structure**

```
XyzDataBlock ::= [APPLICATION <tagNumber>] SEQUENCE {
  versionBlock [0] VersionBlock,
  representationBlocks [1] RepresentationBlocks,
  ...
}
VersionBlock ::= SEQUENCE {
  generation [0] VersionGeneration,
  year [1] VersionYear,
  ...
}
```

RepresentationBlocks ::= SEQUENCE OF RepresentationBlock

## Abstract Syntax in ASN.1

### Resulting tagged binary encoding

Тад	Length	Value							Presence
64 <sub>Hex</sub> or	Variable	Finger ima	age data bl	ock or face					
65 <sub>Hex</sub>		Тад	Length	Value	Value				
		A0 <sub>Hex</sub>	7	Version block					Mandatory
				Tag Length Value					
	80 <sub>Hex</sub> 1 Generation (3)			Mandatory					
				81 <sub>Hex</sub> 2 Year (2019)					Mandatory
		A1 <sub>Hex</sub>	Variable	Representation blocks				Mandatory	
				Tag Length Value					
				30 <sub>Hex</sub> Variable Representation block				At least one	
						Тад	Length	Value	
						See ISO/IE respective	C 39794-4 ly	or -5,	

## Type Definitions in XML

### **Basic Structure**

```
<xs:complexType name="XyzDataBlockType">
  <xs:sequence>
    <xs:element name="versionBlock" type="cmn:VersionBlockType"/>
    <xs:element name="representationBlocks" type="RepresentationBlocksType">
    <xs:any namespace="##other" processContents= "lax" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="VersionBlockType">
  <xs:sequence>
    <xs:element name="generation" type="VersionGenerationType"/>
    <xs:element name="year" type="VersionYearType"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="RepresentationBlocksType">
 <xs:sequence>
    <xs:element name="representationBlock" type="RepresentationBlockType" maxOccurs="unbounded"/>
```

```
</xs:sequence>
```

```
</xs:complexType>"
```

## **Common Data Elements**

### Defined in the framework ISO/IEC 39794-1

- Describing the contents and defining the encoding of data elements common to all formats in ISO/IEC 39794:
  - Version block
  - Model identifier block
  - Certification identifier block
  - Capture date/time block
  - Quality block(s)
  - PAD (presentation attack detection) data block
  - Extended data block(s)
- Other parts of the ISO/IEC 39794 series import these definitions from ISO/IEC 39794

## **Transition Guidelines 49794**

### Transition examples from ISO/IEC 19794 First Edition to ISO/IEC 39794 for ID documents

https://www.iso.org/standard/78018.html



ISO/IEC JTC 1/SC 37 N 7274

ISO/IEC JTC 1/SC 37 "Biometrics" Secretariat: ANSI Committee Manager: Miller Michaela Ms



#### Ballot Text of DTR 49794, Information technology – Transition examples from ISO/IEC 19794 First Edition to ISO/IEC 39794 for ID documents

Document type	Related content	Document date	Expected action
Ballot / Reference document		2021-04-09	VOTE by 2021-06-05
nristoph Busch	Biometric Data	Interchange Standards	2021-04-19

## **Transition Guidelines 49794**

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## **Transition Guidelines 49794**

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## Transition from 19794-x to 39794-x

The evolution took some time ...

• ... but the result is ready to walk and work



Image Source: https://pixabay.com/de/illustrations/evolution-entwicklung-zukunft-3543775/

# Fingerprint Sample Quality NFIQ2.0

# **Quality Metrics for Fingerprint Images**

### NFIQ2.0

- The Entry Exit System implementing decision 2019/329 defines the mandatory use:
- "At the moment of enrolment, the version 2.0 (or newer version) of the Fingerprint Image Quality (NFIQ) metric .... shall be used for verifying that the quality of the captured fingerprint data respects the thresholds ..."



## **Quality Metrics for Fingerprint Images**

### The NFIQ2.0 approach

• Measure quality by filtering the signal and determine the utility of a fingerprint sample.



 Providing constructive feedback only possible if cause of poor quality is known.



NFIQ2.0 constitutes the content of ISO/IEC 29794-4

http://www.christoph-busch.de/projects-nfiq2.html

## **Quality Metrics for Fingerprint Images**

### How was NFIQ2.0 developed?



## Fingerprint Quality in Covid-19 Times

# VIS / EES will need NFIQ2.1 for contactless capture devices

- Covid-19 will follow us for some more time
- Contactless devices will be demanded (rather soon)
- Join NIST, euLISA and EAB, when they organise the joint conference on NFIQ2.1 to be re-trained / calibration for contactless capture devices
- get involved in the discussion on NFIQ2.1 and contribute training data
- https://eab.org/events/program/248



Save the date: June 15th and 16th



Image Source: https://www.semanticscholar.org/paper/Contactless-3D-Fingerprint-Identification-Kumar

## Fingerprint Quality in Covid-19 Times

### Agenda

Tuesday Ju	une 15th				
Start	End	Duration [min]	Speaker	Organization	Торіс
13:00	13:05	5	Christoph Busch / Ralph Lessmann	EAB	Welcome
13:05	13:35	30	Elham Tabassi	NIST	Sample Quality Framework and History of NFIQ
13:35	14:15	40	Martin Olsen / Christoph Busch	HDA	NFIQ2 Features and Concepts
14:15	14:35	20	Coffee break		
14:35	15:05	30	Greg Fiumara	NIST	NFIQ2 Evolution and GitHub
15:05	15:25	20	Ralph Lessmann	HID	Deployment in mobile Applications
15:25	15:55	30	Johannes Merkle	secunet	Deployment Reports
15:55	16:55	60	Panel: User experience and expectation - from call for tender to deployed systems		ed systems
			Scope: experience interpreting scores (operator focus) and policy decisions (administrative focus)		
		Moderator	Dinusha Frings	EAB	
		Panelists	Anne Wang	Thales	
			Javier Galbally	JRC	
			Miceky Cohen	Shanit	
			Johannes Merkle	secunet	

Save the date: June 15th and 16th



## Fingerprint Quality in Covid-19 Times

### Agenda

Wednesday June 16th					
Start	End	Duration [min]	Speaker	Organization	Торіс
13:00	13:30	30	Christopher Schiel	ВКА	Rolled Fingerprint Sample Quality
13:30	14:00	30	Jannis Priesnitz	HDA	NFIQ2 for non-contact Fingerprint Capture Device:
14:00	14:30	30	John Libert	NIST	Non-Contact fingerprint
14:30	14:50	20	Coffee break		
14:50	15:20	30	Istvan Racz	eu-LISA	NFIQ2 in the Context of the Entry-Exit-System
15:20	15:50	30	Andreas Uhl	PLUS	NFIQ2 for synthetic Data
15:50	16:20	30	Ralph Lessmann	HID	Retraining Tool Set
16:20	17:20	60	60 Panel: How to adapt the NFIQ2-model for non-contact fingerprint samples		ples
			Scope: potential of the NFIQ2 model with res	spect to further impressio	n types (non-optical fingerprints)
		Moderator	Christoph Busch		
		Panelists	John Libert	NIST	
			Greg Fiumara	NIST	
			Ralph Lessmann	HID	
			Istvan Racz	eu-LISA	
			Vincent Bouatou	Idemia	

Save the date: June 15th and 16th



## Introduction

### European Association for Biometrics (EAB)

- The EAB is a non-profit, nonpartisan association https://eab.org/
- EAB supports all sections of the ID community across Europe, including governments, NGO's, industry, associations and special interest groups and academia.



 Our role is to promote the responsible use and adoption of modern digital identity systems that enhance people's lives and drive economic growth.



## Introduction

## European Association for Biometrics (EAB)

- Our initiatives are designed to foster networking
  - Annual conference: EAB-RPC https://eab.org/events/program/195
  - Biometric Training Event https://eab.org/events/program/208

European Association for Biometrics Biometrics Human Identity in Europe

- Workshops on relevant topics (e.g. Presentation Attack Detection, Morphing Attack Detection, Sample Quality, Bias in Biometric Systems)
   https://eab.org/events/
- Online Seminar every second week https://eab.org/events/program/245
- Recorded keynote talks https://eab.org/events/lectures.html
- Monthly newsletter https://eab.org/news/newsletter.html
- Annual academic graduation report

https://eab.org/upload/documents/1799/EAB-research-report-2019.pdf



Face Sample Quality Face Quality Scoring Algorithm

### **Relevant standards**

- ISO/IEC 29794-1: Quality Framework
  - Definitions and evaluation concepts <a href="https://www.iso.org/standard/62782.html">https://www.iso.org/standard/62782.html</a>
- ISO/IEC 29794-4: Fingerprint image quality
  - https://www.iso.org/standard/62791.html
  - NFIQ 2.1 https://github.com/usnistgov/NFIQ2 https://www.nist.gov/system/files/documents/2018/11/29/nfiq2\_report.pdf
- ISO/IEC 29794-5: Face image quality
  - Revision of ISO/IEC 29794-5:2011 https://www.iso.org/standard/81005.html
  - Scalar values
  - Vector values ~ Quantitative ISO/ICAO compliance checklist

### ISO/IEC 29794-5 started to be aligned with both

- ISO/IEC 19794-5:2011
- ISO/IEC 39794-5:2019
- Definitions
  - 6.2 Unified quality score FaceQnet (JRC)
  - 6.3 Capture-related quality elements
  - 6.4. Subject-related quality elements



a) Compliant image b) Low contrast source: ISO/IEC 39794-5:2019, Annex D https://www.iso.org/standard/72156.html



images with +8 degrees (left) and -8 degrees (right) rotation in roll Image Source: ISO/IEC 19794-5:2011



### ISO/IEC 2ndWD 29794-5 to be aligned with both

# ISO/IEC 19794-5:2011ISO/IEC 39794-5:2019

Table 2 - Conformance reauirements by activ

#	Image quality aspect	Collection of reference samples for ID credentials	Collection of probe for instantaneous verification	Enrolment for other enrolment, delayed verification, probe later used as enrolment	
1	Unified quality score	6.2	6.2	6.2	
2	Illumination uniformity	6.3	6.3 optional	6.3 optional	
3	Illumination mean	6.3.3.2	6.3.3.2 optional	6.3.3.2 optional	
4	Illumination variance	6.3.3.3	6.3.3.3 optional	6.3.3.3 optional	
5	Illumination skewness	6.3.3.4	6.3.3.4 optional	6.3.3.4 optional	
6	Illumination kurtsosis	6.3.3.5	6.3.3.5 optional	6.3.3.5 optional	
7	Illumination under-exposure	6.3.3	6.3.3 optional	6.3.3 optional	
8	Illumination over-exposure	6.3.5	6.3.5 optional	6.3.5 optional	
9	Dynamic Range	6.3.6	6.3.6 optional	6.3.6 optional	
10	De-focus	6.3.7	6.3.7 optional	6.3.7 optional	
11	Image sharpness	6.3.8	6.3.8 optional	6.3.8 optional	
12	Motion blur	6.3.9	6.3.9 optional	6.3.9 optional	
13	Edge Density	6.3.10	6.3.10 optional	6.3.10 optional	
14	Compression	6.3.11			
15	Unnatural colour and colour balance	6.3.12	6.3.12 optional	6.3.12 optional	
16	Eyes visible	6.4	6.4 optional	6.4	
17	Number of faces present		mandatory	Even more mandatory	
18	Inter-eye distance	6.4.3	6.4.3	6.4.3	
19	Horizontal position of the face	6.4.4	6.4.4	6.4.4	
20	Vertical position of the face	6.4.5	6.4.5	6.4.5	
21	Background uniformity	6.4.6			
22	Pose	6.4.7	6.4.7 optional	6.4.7	
23	Expression neutrality	6.4.8	6.4.8 optional	6.4.8 optional	
24	Mouth closed	6.4.9	6.4.9 optional	6.4.9	
25	Eyes open	6.4.10	6.4.10 optional	6.4.10 optional	
26	Developer-defined quality score computation	8 and Annex A	8 and Annex A	8 and Annex A	

source: ISO/IEC 2ndWD 29794-5, Table 2 https://www.iso.org/standard/81005.html



a) Compliant image b) Low contrast source: ISO/IEC 39794-5:2019, Annex D https://www.iso.org/standard/72156.html



images with +8 degrees (left) and -8 degrees (right) rotation in roll Image Source: ISO/IEC 19794-5:2011



### ISO/IEC 2ndWD 29794-5 quality elements in detail

1.	Unified quality score	С
2.	Left-right symmetry	С
3.	First moment: Brightness	С
4.	Second moment: Variance	С
5.	Third moment: Skewness	С
6.	Fourth moment: Kurtosis	С
7.	Illumination non-underexposure	С
8.	Illumination overexposure	С
9.	Dynamic range	С
10.	De-focus	С
11.	Image sharpness	С
12.	Motion blur	С
13.	Edge Density	С
14.	Compression	С
15.	Unnatural colour, colour balance	С
16.	Eyes visible	S
17.	Inter-eye distance	S
18.	Horizontal position of the face	S
19.	Vertical position of the face	S
20.	Background uniformity	S
21.	Pose	S
22.	Expression neutrality	S
23.	Mouth closed	S
24.	Eyes open	S
25.	Number of faces present	С

e.g. FaceQnet

### This is a draft table

- "C" mean Capture Device related
- "S" mean Subject related

## **Quality Metrics for Facial Images**

### How to develop face quality metrics? - Standardisation

• 2021 - 2024





Christoph Busch Patrick Grother

NIST FRVT Quality Assessment

https://pages.nist.gov/frvt/html/frvt\_quality.html

 International Organization for Standardization, ISO/IEC 29794-5, Information technology - Biometric sample quality -Part 5: Face image data", to appear

https://www.iso.org/standard/81005.html

### • Join the SC37 WG3 work!

https://www.iso.org/members.html

## **Quality Metrics for Facial Images**

### How to develop face quality metrics? - Consensus Building

• 2021 - 2024





Christoph Busch Patrick Grother

- Joint conference of the team (NIST-EAB)
  - to develop the specification for the OS-QSA under participation of the stakeholders (i.e. the end users)
  - Iike we did in the past with IFPC 2020 and IFPC 2018
    - in cooperation of NIST and EAB

https://www.nist.gov/news-events/events/2020/10/international-face-performance-conference-ifpc-2020

https://www.nist.gov/news-events/events/2018/11/international-face-performance-conference-ifpc-2018

European Association for Biometrics

Human Identity in Europe

## Contact

