PD CEN/TR 18030:2023

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Personal identification — Biometrics — Overview of biometric verification systems implemented across Europe

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The UK participation in its preparation was entrusted to Technical Committee IST/44, Biometrics.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Published by BSI Standards Limited 2024

ISBN 978 0 539 26675 7

ICS 35.240.15

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 January 2024.

Amendments/corrigenda issued since publication

Date	Text affected

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TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER REPORT

CEN/TR 18030

December 2023

ICS 35.240.15

English Version

Personal identification - Biometrics - Overview of biometric verification systems implemented across Europe

Persönliche Identifikation - Verwendung biometrischer Verifikationsdaten in allen EU-Ländern und Szenarien

This Technical Report was approved by CEN on 24 December 2023. It has been drawn up by the Technical Committee CEN/TC 224.

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Contents

Page

European foreword 4
Introduction 5
1 Scope 6
2 Normative references 6
3 Terms and definition s 6
4 Symbols and abbreviated terms 7
5 State of the art using biometrics in interoperable scenarios 8
5.1 General 8
5.2 Standardization applied to the enrolment 8
5.3 Standardization applied to the storage 8
5.4 Standardization applied to the communication between nodes of a biometric network 9
5.5 Standardization applied to the use of biometrics 9
5.6 Standardization applied to the environment 10
5.7 Standardization applied to the quality assurance 11
5.8 Standardization applied to the data security assurance 11
5.9 Use of biometrics in border control 13
6 Technical challenges of a biometric system with interoperability 14
7 Challenges related to the acquisition of biometric data 15
7.1 General 15
7.2 Acquisition requirements during the recognition phase 16
7.3 Acquisition requirements during the enrolment phase 17
7.4 Examples of acquisition challenges 17
7.4.1 General 17
7.4.2 Fingerprint images: comparison among semiconductor sensors and quality algorithms 17
Table 1 — Main characteristics of the sensors used 18
Figure 1 — Distribution of Quality Scores for Acquisition accepted samples in sensor 1 18
Figure 2 — Distribution of Quality Scores for Acquisition accepted samples in sensor 2 19
Figure 3 — Distribution of Quality Scores for Acquisition accepted samples in sensor 3 19
Figure 4 — Distribution of Quality Scores for Acquisition accepted samples in sensor 4 20
Figure 5 — Distribution of Quality Scores for Acquisition accepted samples in sensor 5 20
Figure 6 — Distribution of Quality Scores for Acquisition Errors in sensor 1 21
Figure 7 — Distribution of Quality Scores for Acquisition Errors in sensor 2 22
Figure 8 — Distribution of Quality Scores for Acquisition Errors in sensor 3 22
Figure 9 — Distribution of Quality Scores for Acquisition Errors in sensor 4 23
Figure 10 — Distribution of Quality Scores for Acquisition Errors in sensor 5 23
8 Challenges in the recognition process 24

Documents
Document Sharing Hub
Full document details: PD CEN/TR 18030:2023

8.1 General ... 24
8.2 Examples of recognition challenges ... 24
8.2.1 General ... 24
8.2.2 Face recognition in Spanish ABC points ... 24
Table 2 — EER values obtained by the different algorithms/versions used ... 25
Table 3 — FRR values obtained by the different algorithms/versions used ... 26
8.2.3 Face verification results in NIST FRVT 1:1 on-going evaluation ... 26
Figure 11 — FRVT 1:1 Verification results for products 1 to 6 ... 28
Figure 12 — FRVT 1:1 Verification results for products 121 to 126 ... 29
Figure 13 — FRVT 1:1 Verification results for products 391 to 396 ... 29
8.2.4 Fingerprint verification results in public evaluations/competitions ... 30
Table 4 — Excerpt of some results from FVC 2006 ... 31
9 Recommendations for the future ... 32
Bibliography ... 33

Documents
Document Sharing Hub

Full document details: PD CEN/TR 18030:2023

European foreword

This document (CEN/TR 18030:2023) has been prepared by Technical Committee CEN/TC 224 "Personal identification and related personal devices with secure element, systems, operations and privacy in a multi sectorial environment", the secretariat of which is held by AFNOR.

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Introduction

From the beginning of the century, the use of biometrics in real applications has been more and more extended to other environments different than forensic analysis. With this focus, thorough studies about normalized mechanisms to harmonize the use of biometrics have been made. Many relevant institutions, public and private, have collaborated to obtain standards, technical reports, etc. towards best practices of biometrics.

From the point of view of organizations at the international, European and national level, a big organizational process has been developed. Other organizations have used and adapted current standards to produce their own normative related with the use of biometrics (i.e. ICAO, Frontex, Eu-Lisa, etc).

Biometrics networks where lots of nodes collaborate to obtain the distributed biometrics storage and matching have been implemented in the public (Eurodac, Interpol, etc) and private scenarios.

It is well known the huge number of challenges that have to be faced when a biometric solution is being deployed, in particular when trying to cover a high level of interoperability. One example of these challenges is the difficulty that system integrators (and service providers) have to face when choosing which capture device will they use, as they can only rely on the figures provided by the manufacturer, which sometimes are incomplete. Another example is the rigourness in applying quality requirements to biometric references and probes in different applications or even countries.

A perfect example of this challenge is border control, where the system has to be able to manage ePassports from all around the world, as well as subjects of all kinds. Even with the high number of international standards available nowadays, plus some additional requirements (e.g. those issued by FRONTEX), a huge variety of cases have to be handled, including differences in how the information is stored in the ePassports, the acquisition scenario and requirements, or even the acceptance thresholds.

The aim of this technical report is to analyse the current state of art in biometrics standardization, its use, and the identification of gaps between all the relevant standards used in environments applying the European laws and normative to the applications.

The detected gaps are identified in order to promote the modification of the current standards on biometrics or/and the generation of new standards in Europe.

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1 Scope

This document provides an overview of the current deployment of biometric systems within Europe. It addresses the challenges that are being faced, in order to detect the current needs for improving the specifications for the implementation and deployment of biometric systems. This document considers all kind of deployments, from border control to ad hoc services. As most of the deployed systems are based on the use of fingerprints or face recognition, this document will focus on these two biometric modalities, from the system integrator and interoperability points of view.

Identity documents, in terms of production, structure, interoperability, etc., are out of the scope of this document. The document is focused on the performance at system level.

The current European legislative initiatives around this topic (e.g. Entry/Exit System, framework for interoperability between EU information systems, etc.) need a robust framework study about the availability of standard technologies to improve interoperability in biometric products around the European Union.

By showing these needs, a set of recommendations for future standardization works is provided.

From a methodological perspective, the report gathers information of different entities with this classification:

— Capture/enrolment of biometrics including the quality assurance and the generation of feature or biometric models from the images.

— Best practices and guidelines to use biometrics in Europe.

— Data Quality environment using biometrics in European networks.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 17054, *Biometrics multilingual vocabulary based upon the English version of ISO/IEC 2382-37:2012*

ISO/IEC 2382-37, *Information technology — Vocabulary — Part 37: Biometrics*

3 Terms and definition s

For the purposes of this document, the terms and definitions given in ISO/IEC 2382-37 and EN 17054 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at https://www.electropedia.org/

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4 Symbols and abbreviated terms

ABC	Automated Border Control
ACBio	Authentication context for biometrics (ISO/IEC 24761:2019)
API	Application Programming Interface
BIP	BioAPI Internetworking Protocol (see ISO/IEC 24708:2008)
CBEFF	Common Biometric Exchange Formats Framework (see ISO/IEC 19785-1:2020)
DET	Detection Error Tradeoff curve (see ISO/IEC 19795-1:2021)
DO	Data Object (see ISO/IEC 7816-4:2020)
EER	Equal Error Rate (see ISO/IEC 19795-1:2021)
FAR	False Acceptance Rate (see ISO/IEC 19795-1:2021)
FIPS	Federal Information Processing Standards
FMR	False Match Rate (see ISO/IEC 19795-1:2021)
FNMR	False Non-Match Rate (see ISO/IEC 19795-1:2021)
FRR	False Rejection Rate (see ISO/IEC 19795-1:2021)
FRVT	Face Recognition Vendor Test (see https://www.nist.gov/programs-projects/face-recognition-vendor-test-frvt)
FVC	Fingerprint Verification Competition (see https://biolab.csr.unibo.it/fvcongoing/UI/Form/Home.aspx)
ICAO	International Civil Aviation Organization (see https://www.icao.int/Pages/default.aspx)
ICC	Integrated Circuit Card (see ISO/IEC 7816-4:2020)
ID1	ID1 Form Factor for Identification cards (see ISO/IEC 7816-1:2011)
LDS	Logic data Structure, as defined by ICAO Doc 9303–10 (see https://www.icao.int/publications/pages/publication.aspx?docnum=9303)
MRTD	Machine Readable Travel Document, as defined by ICAO Doc 9303 (see https://www.icao.int/publications/pages/publication.aspx?docnum=9303)
NFIQ	NIST Fingerprint Image Quality, as defined in https://www.nist.gov/services-resources/software/nfiq-2
NIST	National Institute for Standards and Technology (see https://www.nist.gov/)
NTWG	ICAO's New Technologies Working Group (see http://www.icao.int)
OASIS	Organization for the Advancement of Structured Information Standards (see https://www.oasis-open.org/)
PAD	Presentation Attack Detection (see ISO/IEC 30107-1:2023)
ppi	points per inch (also known as ppi – points per inch)
PPs	Protection Profiles, as defined in https://www.commoncriteriaportal.org/pps/
REST	Representational State Transfer (see ISO/IEC 30108-2:2023)
ROC	Receiver Operating Characteristic (see ISO/IEC 19795-1:2021)
SOA	Service Oriented Architecture

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SOAP	Simple Object Access Protocol
STs	Security Targets, as defined in https://www.commoncriteriaportal.org/
TD1-TD3	as defined by ICAO Doc 9303 (see https://www.icao.int/publications/pages/publication.aspx?docnum=9303)
XML	Extensible Markup Language

5 State of the art using biometrics in interoperable scenarios

5.1 General

The use of biometrics is subject to a set of standards and specifications. Within this clause, several subclauses deal with the standards and documents involved. The idea is to direct the reader to those documents that are applicable and that can help to better understand the content of this Technical Report.

5.2 Standardization applied to the enrolment

From the application point of view, ISO/IEC TR 29196 "Information technology — Guidance for biometric enrolment" consolidates information relating to successful, secure and usable implementation of biometric enrolment processes, while indicating risk factors that organisations proposing to use biometric technologies will address during procurement, design, deployment and operation.

CEN/TS 17661 consolidates information relating to successful and high-quality biometric enrolment processes of facial and fingerprint systems, while indicating risk factors and providing appropriate mitigations.

On the other hand, CEN/TS 16634:2014 "Personal identification - Recommendations for using biometrics in European Automated Border Control" provides very valuable information on the use of biometrics for border control, but enrolment is considered out of its scope.

5.3 Standardization applied to the storage

For the storage of information there are two topics that are of importance. The first one is about the format of the data where biometric information is provided, and the second one is how to store that data into a storage device.

Regarding the first point, biometric data formats are mainly provided ISO/IEC JTC1/SC37 WG3, while their encapsulation is provided by ISO/IEC JTC1/SC37 WG2. ISO/IEC 19794 series provide interoperable ways to code biometric data, depending on the modality. This multipart standard provides a framework to be applied to all parts, some data formats for captured sample data (e.g. sample images), and some others for processed sample data (e.g. fingerprint minutiae data). This family of standards have currently two different generations defined, that are both still accepted. Also, there is a 3rd generation standardized under the series ISO/IEC 39794 for extensible interchange biometric data formats, which are expected to supersede ISO/IEC 19794 in a near future. Currently, only the first generation is considered for border control, and in particular the use of finger image, face image and/or iris image. In a future, 3rd generation (i.e. ISO/IEC 39794) is expected to be applicable to ePassports. ISO/IEC TR 30117 provides an in-depth explanation on the structures and differences between ISO/IEC 19794 and ISO/IEC 39794 family of standards.

In addition to the data formats defined in ISO/IEC 19794 and ISO/IEC 39794 which are defined as to include the information from a single user and a single modality, SC 37 has also defined a meta-structure called CBEFF (i.e. ISO/IEC 19785 series of standards), that allows:

— the coding of biometric information from more than a single user;

— the coding of biometric information from more than one modality; and

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— protecting biometric data by using security mechanisms that will cipher and/or authenticate the data included into the CBEFF BIR structure.

In-depth explanation on CBEFF can also be found in ISO/IEC TR 30117. For the case of adding biometrics into a document, such as an ePassport, Clause 11 of ISO/IEC 19785-3 is important, as it provides the structure on how the information has to be stored.

Regarding the way biometric data are placed into a storage device, there is a comprehensive standardization provided by ISO/IEC JTC1/SC17. In the case of using an Integrated Circuit Card (ICC), biometric data are encapsulated according to ISO/IEC 7816 series, where either the biometric information template DO'7F60' or the biometric information group template DO'7F61' defined in ISO/IEC 7816-11 are considered. In particular, ISO/IEC 7816-11 provides the information on how biometric information has to be recorded in an ICC.

Last, but not least, when border control is in the scope, the specification provided in ICAO 9303 is mandatory for Machine Readable Travel Documents (MRTD), such as the ePassport.

5.4 Standardization applied to the communication between nodes of a biometric network

When a recognition system has to exchange biometric information, it is important to refer to ISO/IEC JTC1/SC37 WG2 developed standards. In 2008 they published ISO/IEC 24708 "BioAPI Interworking Protocol" (BIP), but unfortunately has not been widely adopted, mainly due to huge changes into client-server architecture technologies.

Nowadays is more frequent to talk about web-service based solutions, and in order to address this need BIAS (i.e. Biometric Identity Assurance Services) was created by OASIS. Later on, BIAS was submitted to ISO/IEC JTC1 SC37, where it was refined and renamed, becoming ISO/IEC 30108-1 "Identity Attributes Verification Services — Part 1: IAVS Services". This first part of IAVS was developed as an XML-based specification for allowing the exchange of identity information (including also non-biometric data) in Service Oriented Architectures (SOA). It was intentionally created as implementation independent, although it gets pretty close to Simple Object Access Protocol (SOAP), i.e. the Microsoft approach to web services.

But many applications prefer to use REST (i.e. Representational State Transfer), due to being simpler and lighter. Therefore, SC 37 decided to develop ISO/IEC 30108-2 for the specification of IAVS in accordance to a RESTful implementation.

5.5 Standardization applied to the use of biometrics

There are several standards and technical reports published, that are a reference for a system designer and/or developer, when defining certain applications. This is defined under the umbrella of different WGs, and includes a reasonable number of standards:

— ISO/IEC JTC 1/SC 37 WG4 defines some biometric application profiles. In particular the following documents could be of interest:

  — ISO/IEC 20027, Information technology - Guidelines for slap tenprint fingerprintture

  — ISO/IEC TR 30125, Biometrics used with mobile devices

  — ISO/IEC TR 29195, Traveller processes for biometric recognition in automated border control systems

  — ISO/IEC 24713-1, Biometric profiles for interoperability and data interchange –Part1: Overview of biometric systems and biometric profiles

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