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Information technology — Extensible biometric data interchange formats —

Part 16: Full body image data

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

A list of all parts in the ISO/IEC 39794 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

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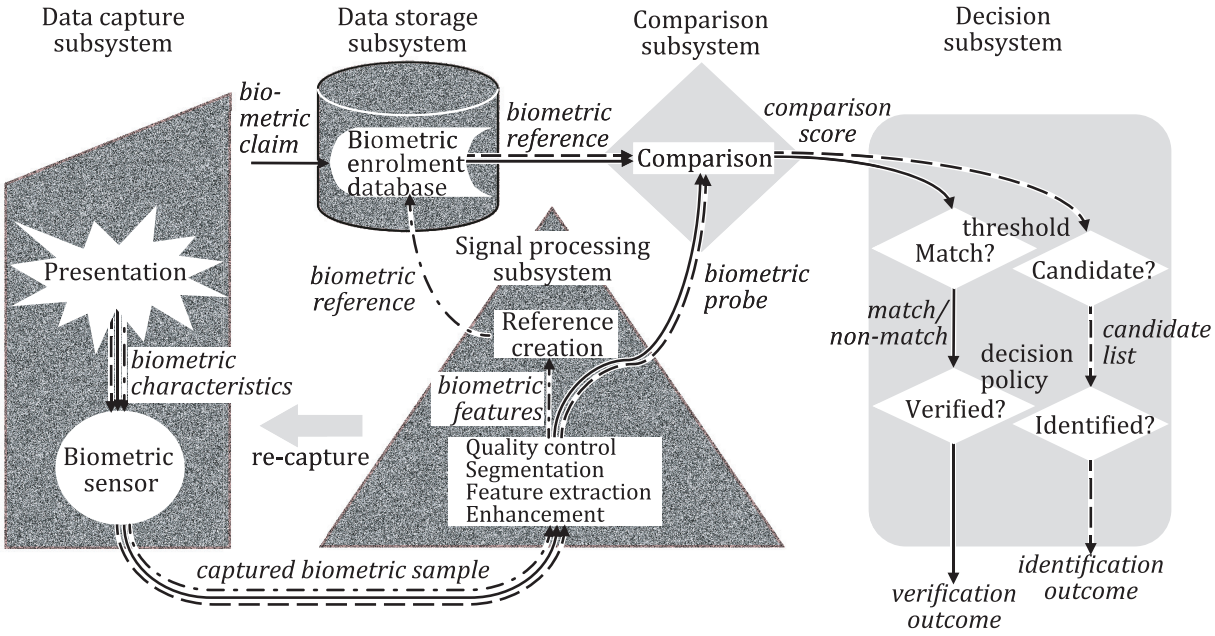
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Introduction

Most countries around the world use biometric recognition systems for law enforcement and border control. Many of these systems are not limited to face recognition purposes. To be consistent in such deployments and processes, technical documents, guidelines and best practice recommendations are being developed by different groups. These documents are primarily focused on the issuance and use of identity documents and related border control systems, and the technical and operational issues to be considered when planning and deploying them. "Face" is the biometric mode most suited to the practicalities of travel documents and automated border processing. "Full body" is a biometric mode that can be used in addition to face (for example, in border-crossing watchlist scenarios, crime surveillance, etc.). Full body can also be used in forensic scenarios.

There is very little guidance covering full body imaging for cross-border or law enforcement biometric recognition purposes. There is a need for guidance for the use of high-quality digital cameras and video surveillance devices, as well as guidance on full body data interchange structure semantics, syntax and format for the collection and use of full body image data in biometric recognition scenarios. A specific extensible biometric data interchange format for cross-border interoperability is required for full body images. Full body image data standardization is required to ensure threshold quality for database images for identification and verification using video surveillance and other similar system-generated images.

Figure 1 illustrates components of a full body image biometric system on a checkered background.



Key

enrolment

verification

identification

NOTE Figure 1 shows the information flow within a general biometric system, showing a general biometric system consisting of data capture, signal processing, data storage, comparison and decision subsystems. Each of these subsystems are defined in ISO/IEC 39794-1 in more detail.

Figure 1 — Components of a biometric system

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Border personnel, immigration officials and police officers take full body images using local practices where no international standards are available to outline the practices which enable cross-border interoperability. This document can therefore be helpful for the description of the full body biometric characteristics and associated non-biometric information for identification purposes in disaster victim and law enforcement scenarios (e.g. victim identification, unknown bodies and missing individuals).

To enable applications on a wide variety of devices, including devices that have limited data storage, and to improve biometric recognition accuracy, other parts of the ISO/IEC 39794 series address data format, scene constraints (lighting, pose, expression, etc.), photographic properties (positioning, camera focus, etc.), and digital image attributes (image resolution, image size, etc.).

In order to fully understand the requirements implied in this document, it is recommended that the user become acquainted with certain other documents:

— ISO 22311: this document specifies a common output file format that can be extracted from the video-surveillance contents collection systems to perform necessary processing.

— The ISO/IEC 30137 series: this series specifies the use of biometrics in video surveillance systems.

— EN 62676[22]: this document defines video surveillance systems for use in security applications.

This document (ISO/IEC 39794-16) is originally based on CEN/TS 17051.

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Information technology — Extensible biometric data interchange formats —

Part 16: Full body image data

1 Scope

This document is intended to provide a generic extensible full body image data format for biometric recognition applications requiring exchange of human full body image data. Typical applications are:

a) automated body biometric verification and identification of an unknown individual or cadaver (one-to-one as well as one-to-many comparison);

b) support for human verification of identity by comparison of individuals against full body images; and

c) support for human examination of full body images with sufficient resolution to allow a human examiner to verify identity or identify a living individual or a cadaver.

This document ensures that full human body images and image sequence data generated by video surveillance and other similar systems are suitable for identification and verification.

The structure of the data format in this document is compatible with ISO/IEC 39794-5. In addition to the data format, this document specifies application-specific profiles including scene constraints, photographic properties and digital image attributes like image spatial sampling rate, image size, etc. These application profiles are contained in a series of annexes.

The 3D encoding types "3D point map" and "range image" are not supported by this document.

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.

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

ISO/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1) — Part 1: Specification of basic notation*

ISO/IEC 10918-1, *Information technology – Digital compression and coding of continuous-tone still images: Requirements and guidelines*

ISO 12052, *Health informatics — Digital imaging and communication in medicine (DICOM) including workflow and data management*

ISO 12233, *Photography — Electronic still picture imaging — Resolution and spatial frequency responses*

ISO/IEC 14496-2:2004, *Information technology — Coding of audio-visual objects — Part 2: Visual*

ISO/IEC 14496-10, *Information technology — Coding of audio-visual objects — Part 10: Advanced video coding*

ISO/IEC 14496-14, *Information technology — Coding of audio-visual objects — Part 14: MP4 file format*

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ISO/IEC 15444-1, *Information technology — JPEG 2000 image coding system — Part 1: Core coding system*

ISO/IEC 15444-3, *Information technology — JPEG 2000 image coding system: Motion JPEG 2000 — Part 3*

ISO/IEC 15948, *Information technology — Computer graphics and image processing — Portable Network Graphics (PNG): Functional specification*

ISO/IEC 39794-1, *Information technology — Extensible biometric data interchange formats — Part 1: Framework*

ISO/IEC 39794-5, *Information technology — Extensible biometric data interchange formats — Part 5: Face image data*

ITU-T Rec. T.81, *Information technology — Digital compression and coding of continuous-tone still images — Requirements and guidelines*

ITU-T Rec. T.802, *Information technology — JPEG 2000 image coding system: Motion JPEG 2000*

XML Schema Part 1: Structures Second Edition, W3C Recommendation, 28 October 2004, http://www.w3.org/TR/xmlschema-1/

XML Schema Part 2: Datatypes Second Edition, W3C Recommendation, 28 October 2004, http://www.w3.org/TR/xmlschema-2/

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 39794-1 and ISO/IEC 2382-37 and the following apply.

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

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

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

3.1
2D image
two-dimensional biometric capture *subject* (3.67) body representation that *encodes* (3.18) the luminance and/or colour variations of a biometric capture subject in a given lighting environment or a set of images recorded using required radiation bandwidths

3.2
3D shape
DEPRECATED 3D image
three-dimensional biometric capture *subject* (3.67) body representation that *encodes* (3.18) a surface or a volumetric shape in a 3D space

3.3
3D point map
3D point cloud representing a biometric capture *subject* (3.67), where each surface point is encoded with a triplet, representing the point as coordinate *values* (3.72) in a 3D *Cartesian coordinate system* (3.10) respectively

3.4
4K
UHDTV resolution of 3840 px × 2160 px to achieve a 16 × 9 aspect ratio

Note 1 to entry: UHDTV is an abbreviation for Ultra High Definition Television, defined in documents: SMPTE ST 2036-1 and Recommendation ITU-R BT.2020.

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3.5
anthropometric landmark
landmark point on the biometric capture *subject* (3.67) representation used for identification and classification of humans

3.6
artificial intelligence
AI
discipline concerned with the building of computer systems that perform tasks requiring intelligence when performed by humans

3.7
biometric feature vector
one-dimensional *matrix* (3.48) representation of biometric features

Note 1 to entry: Feature *vector* (3.73) is a list of numbers taken from the output of a *neural network* (3.51) layer or other biometric process capable of creating a one-dimensional matrix representation of biometric features.

3.8
cadaver
dead body of a human

Note 1 to entry: The definition of "cadaver" does not include the dead body of an animal.

3.9
camera to subject distance
CSD
distance between the eyes or the body surface plane of a capture *subject* (3.67) and the sensor/image plane of the camera

Note 1 to entry: In *full body images* (3.32) body surface plane is used when eyes plane is not visible.

3.10
Cartesian coordinate system
3D orthogonal coordinate system

3.11
CIE standard illuminant D65
commonly used standard illuminant defined by the International Commission on Illumination (CIE) that is intended to represent average daylight and has a correlated colour temperature of approximately 6 500 K

Note 1 to entry: CIE standard illuminant D65 is specified in ISO/IEC 11664-2.

3.12
colour image
continuous tone image (3.15) that has more than one channel, each of which is coded with one or multiple bits

3.13
colour space
way of representing colours of pixels in an image

EXAMPLE RGB, YUV and LAB are colour spaces typically used in this document.

3.14
common biometric exchange formats framework
CBEFF
data format specifically for exchanging biometric data that provides for the encompassing of any biometric type into a standard format

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3.15
continuous-tone image
image whose channels have more than one bit per pixel

Note 1 to entry: An image, such as a photograph, where the grey levels in the image are continuous and not discrete.

3.16
Digital Imaging and Communications in Medicine
DICOM
standard for the communication and management of medical *imaging* (3.41) information and related data

Note 1 to entry: The DICOM Standard facilitates interoperability of medical imaging equipment.

Note 2 to entry: DICOM is defined in ISO 12052.

3.17
deoxyribo nucleic acid
DNA
complex molecule found in virtually every cell in the body that carries genetic information from one generation to another

3.18
encode
convert information into a coded form

3.19
eye centre
centre of the line connecting the inner and the outer corner of the eye

Note 1 to entry: The eye centres are the *feature points* (3.25) 12.1 and 12.2 as defined in ISO/IEC 14496-2.

Note 2 to entry: The inner and the outer corner of the eye are defined by ISO/IEC 14496-2. They are the feature points 3.12 and 3.8 for the right eye, and 3.11 and 3.7 for the left eye.

3.20
eye to mouth distance
EMD
distance between the *face centre*, *M* (3.22), and the mouth midpoint

Note 1 to entry: This corresponds to *feature point* (3.25) 2.3 from ISO/IEC 14496- 2.

3.21
f-stop
ratio of the lens focal length to the diameter of the entrance pupil

3.22
face centre
M
midpoint of the line connecting the two *eye centres* (3.19)

3.23
face image
electronic image-based representation of the *portrait* (3.55) of a capture *subject* (3.67)

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3.24
facial animation parameter
FAP
standard for virtual representation which includes visual speech intelligibility, mood and gesture by using *feature points* (3.25)

Note 1 to entry: This standard is specified in ISO/IEC 14496-1 and ISO/IEC 14496-2.

3.25
feature point
reference point in a biometric capture *subject* (3.67) image as used by feature recognition algorithms

Note 1 to entry: Commonly referred to as a landmark, an example being the position of the eyes.

3.26
far-infrared
FIR
section of infrared band with *wavelength* (3.74) from 50 µm - 1000 µm

Note 1 to entry: See ISO 20473.

3.27
fisheye
type of distortion where central objects of the image erroneously appear closer than those at the edge

3.28
forensic
related to methods, techniques and processes used to establish conclusions and/or opinions, facts and findings, which can be used for legal proceedings[SOURCE: ISO 21043-1:2018, 3.14].

3.29
forensic analysis
scientific tests or techniques used in connection with the detection of crime

3.30
Frankfurt Horizon
FH
standard plane for orientation of the head

Note 1 to entry: The Frankfurt Horizon is defined by a line passing through the right tragion (the front of the ear) and the lowest point of the right eye socket. It can be hard to define, as it is related to the ear position, which can be covered by hair.

3.31
full body
anatomical structure of an individual that includes any or all of the head, torso and limbs

Note 1 to entry: Full body refers to a living person or a dead body, and/or *personal data* (3.53) related to this full body.

3.32
full body image
representation of a data *subject* (3.67) covering the *full body* (3.31)

Note 1 to entry: Full body image is not limited to the anatomical structure of the full body as the data subject refers to any individual person who can be identified, directly or indirectly, via an identifier such as a name, an ID number, location data, or via factors specific to the person's physical, physiological, genetic, mental, economic, cultural or social identity.

3.33
gait
subject's (3.67) manner of walking

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3.34
gamma rays
electromagnetic ionizing radiation, emitted by specific radioactive materials

EXAMPLE Cobalt-60 i.e. ^{60}Co.

Note 1 to entry: Gamma rays shall be used only to make examinations of non-living matter i.e. *cadavers* (3.8) or chemical traces.

[SOURCE: ISO 5576:1997, 2.61, modified — EXAMPLE and Note 1 to entry added.]

3.35
gradation
passing by small degrees from one tone or shade, as of colour, to another

3.36
greyscale image
continuous-tone image (3.15) encoded with one luminance channel

Note 1 to entry: For example, if the luminance channel is coded with 8 bits, the greyscale image is also referred to as a monochrome or black and white image.

3.37
histogram
accurate representation of the distribution of numerical data

3.38
human body
data describing the anatomical structure of an individual that includes the head, torso and limbs

3.39
human examination
process of human comparison of the characteristics and structures in a biometric capture *subject* (3.67) image with those of an individual, or those in another biometric capture subject image

3.40
human verification
validation of the identity of a biometric capture *subject* (3.67) image by means of comparison with an individual or other biometric capture subject image

Note 1 to entry: Also known as one-to-one (1:1) comparison.

3.41
imaging
process of making a visual representation of something by scanning it with a detector or electromagnetic beam

Note 1 to entry: Biometric imaging can produce a feature *vector* (3.73) or feature *tensor* (3.68) of the biometric *subject* (3.67) instead of a visual representation.

3.42
inter eye distance
IED
length of the line connecting the *eye centres* (3.19) of the left and right eye

3.43
implementation under test
IUT
implementation of a technical system currently tested

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3.44
lateral
of, at, towards, or from the side or sides

3.45
lower camel-case notation
naming convention in which compound words are joined together without spaces, where the first letter of the entire word is lowercase, and the first letter of subsequent words is uppercase

3.46
machine learning
ML
process by which a functional unit improves its performance by acquiring new knowledge or skills, or by reorganizing existing knowledge or skills

Note 1 to entry: Machine learning is a form of computer *artificial intelligence* (3.6) that uses software based on concepts understood from biological *neural networks* (3.51) to adaptively perform a task.

3.47
magnetics
science of magnetism used in Magnetic Resonance Imaging (MRI) utilizing the body's natural magnetic properties to produce detailed images from any part of the body

Note 1 to entry: Magnetism is a physical property of materials that causes forces between objects, either pulling them towards each other or pushing them apart.

Note 2 to entry: MRI is a non-invasive *imaging* (3.41) technology that produces three dimensional detailed anatomical images without the use of damaging radiation.

3.48
matrix
an arrangement of numbers, symbols, etc. in rows and columns, treated as a single quantity

3.49
mid-infrared
MIR
section of infrared band with *wavelength* (3.74) from 3 µm - 50 µm

Note 1 to entry: See ISO 20473.

3.50
near-infrared
NIR
section of infrared band with *wavelength* (3.74) from 0,78 µm - 3 µm

Note 1 to entry: See ISO 20473.

3.51
neural network
NN
artificial intelligence (3.6) technique that mimics the operation of the human brain

Note 1 to entry: In practice, the neural network is a network of primitive processing elements connected by weighted links with adjustable weights, in which each element produces a *value* (3.72) by applying a nonlinear function to its input values, and transmits it to other elements or presents it as an output value.

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3.52
neutron
subatomic particles used for neutron *imaging* (3.41) (NI) purposes by the neutron attenuation process in a similar fashion to *X-rays* (3.76)

Note 1 to entry: Neutron imaging can be used to detect changes in hydrogen abundance that can be correlated with the *post-mortem* (3.57) interval, i.e. the time that has elapsed since a person has died.

3.53
personal data
information that relates to an identified or identifiable human being

3.54
Portable Network Graphics
lossless image compression standard

Note 1 to entry: This is specified in ISO/IEC 15948.

3.55
portrait
photograph of a capture *subject* (3.67) which includes the full head, with all hair in most cases, as well as neck and top of shoulders

Note 1 to entry: This can also refer to vertical camera orientation which is opposite to landscape orientation.

3.56
positron
positively charged subatomic particle used in the positron emission tomography (PET) *imaging* (3.41) technique

3.57
post-mortem
PM
after death

Note 1 to entry: Sometimes used to refer to examination or autopsy of a corpse in order to determine cause of death.

Note 2 to entry: Latin *post mortem.*

3.58
presentation attack
presentation of an artefact or human characteristic to the biometric capture subsystem in a fashion that can interfere with the intended policy of the biometric system

3.59
presentation attack detection
PAD
automated determination of a *presentation attack* (3.58)

3.60
proton
subatomic particles used in proton computed tomography (pCT, or Proton CT)

3.61
quantum
discrete quantity of energy, proportional in magnitude to the frequency of the radiation it represents

Note 1 to entry: This can also refer to the minimum amount of any physical entity involved in an interaction.

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3.62
quantum entanglement
phenomenon in *quantum* (3.61) mechanics in which a particle or system does not have a definite state but exists as an intermediate form of two 'entangled' states

Note 1 to entry: Quantum entanglement is a physical phenomenon which occurs when pairs or groups of particles are generated, interact, or share spatial proximity in ways such that the quantum state of each particle cannot be described independently of the state of the other(s), even when the particles are separated by a large distance. Instead, a quantum state is described for the system as a whole.

3.63
quantum sensor
piece of equipment that exploits *quantum* (3.61) correlations, such as *quantum entanglement* (3.62), to achieve a sensitivity or resolution that is higher than using only classical systems

3.64
radial distortion
image imperfection where the degree of magnification varies with the distance from the optical axis

3.65
range image
numerical *matrix* (3.48) that *encodes* (3.18) a surface point in 3D space, where the position encodes the first two coordinates and the *value* (3.72) at that position encodes the third coordinate

3.66
submillimetre
terahertz (THz) radiation, known as submillimetre radiation, consisting of electromagnetic waves within the ITU-designated band of frequencies from 0,3 THz to 3 THz (300 GHz - 3000 GHz)

3.67
subject
person who is to be displayed on the image or from whom samples are to be taken

Note 1 to entry: A capture subject becomes a data subject when the subject's biometric samples are entered into a biometric system.

3.68
tensor
mathematical object analogous to but more general than a *vector* (3.73), represented by an array of components that are functions of the coordinates of a space

3.69
texture image
two-dimensional representation of the luminance and/or colour of a biometric capture *subject* (3.67) in a given lighting environment

3.70
ultraviolet radiation
UV
wavelength (3.74) of the electromagnetic spectrum of radiation from 10 nm to 400 nm

[SOURCE: ISO 15858:2016, 3.3, modified — Note 1 to entry removed.]

3.71
upper camel-case notation
naming convention in which compound words are joined together without spaces and the first letter of every word is uppercase

3.72
value
numerical or categorical result assigned to a base measure, derived measure or indicator

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3.73
vector
matrix (3.48) with one row or one column

3.74
wavelength
distance between repeating units of a wave pattern

Note 1 to entry: Commonly designated by the Greek letter lambda (λ).

3.75
white light
apparently colourless light

EXAMPLE Ordinary daylight.

Note 1 to entry: White light contains all the *wavelengths* (3.74) of the visible spectrum from 380 nm to 760 nm at equal intensity, based on human perception.

3.76
X-rays
penetrating electromagnetic radiation, within the approximate *wavelength* (3.74) range of 1 nm to 0,0001 nm, produced when high velocity electrons impinge on a metal target

Note 1 to entry: Wavelength range is from 10 nm to 0,001 nm according to ISO 21348.

[SOURCE: ISO 5576:1997, 2.129, modified — Note 1 to entry added.]

4 Abbreviated terms

2CIF	common interchange format 2 image format having width 704 pixels and height 288 pixels
4CIF	common interchange format 4 image format having width 704 pixels and height 576 pixels
ASN.1	abstract syntax notation one
AVC	advanced video coding
BAP	body animation parameters
BDB	biometric data block
BER	basic encoding rules
B&W	black and white
CAESAR	civilian American and European surface anthropometry resource
CBEFF	common biometric exchange formats framework
CEN	European Committee for Standardization
CIE	International Commission on Illumination (Commission Internationale de l'Eclairage)
CIEDE2000	CIE CIEDE2000 colour-difference formula defined in ISO/CIE 11664-6
CIELAB	CIE 1976 L*a*b* colour space defined in ISO/CIE 11664-4
CIF	common interchange format image format having width 352 pixels and height 288 pixels
CNN	convolutional neural network

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