Biometrics are ready for banking: standards and security

Christoph Busch

Hochschule Darmstadt / Gjøvik University College
http://www.christoph-busch.de/

EAB / FFAUK / BdB / EPCA - Biometrics in Banking

London - October 24, 2014

h_da
HOCHSCHULE DARMSTADT
UNIVERSITY OF APPLIED SCIENCES

Fraunhofer
IGD

HØGSKOLEN I GJØVIK

Agenda

- From Biometric Rumors to Reality
- Mobile Biometrics
- Mobile Payment Protocol
  - Privacy compliant protocol according to the FIDO Universal Authentication Framework (UAF)
  - a suggestion for a „European derivate of Apple Pay“

Answers on Biometric Rumors

Security ?

Operators may think:

„Biometrics are not as secure as PINs“

Benchmark of Biometrics and PIN

There are three striking arguments why biometric authentication is better than the PIN

- Tragedy of the commons

http://en.wikipedia.org/wiki/Tragedy_of_the_commons

- 1.) PINs are exploiting (brains) commons
  - the concept works well, when we have to manage only a few passwords
  - but in reality we are expected to remember more than 100 passwords and we fail to do so

Benchmark of Biometrics and PIN (cont.)

There are three striking arguments why biometric authentication is better than the PIN

- 2.) The entropy of a 4 or 6-digit PIN is very limited
  - Even for a 6 digit numeric PIN (e.g. with the German eID card) the entropy $H = L * log_2 N$ is limited to less than 20bit (with $L=6, N=10$)
  - The reported entropy for dfferent biometric characteristics is
    - Fingerprints 84bit [Ratha2001]
    - Iris 249bits [Daugman2006]
    - Face 56bit [Adler2006]

[Bu2014] N. Buchmann, C. Rathgeb, H. Baier, C. Busch: Towards electronic identification and trusted services for biometric authenticated transactions in the Single Euro Payments Area, in Proceedings of the 2nd Annual Privacy Forum (APF'14), 2014

Benchmark of Biometrics and PIN (cont.)

There are three striking arguments why biometric authentication is better than the PIN

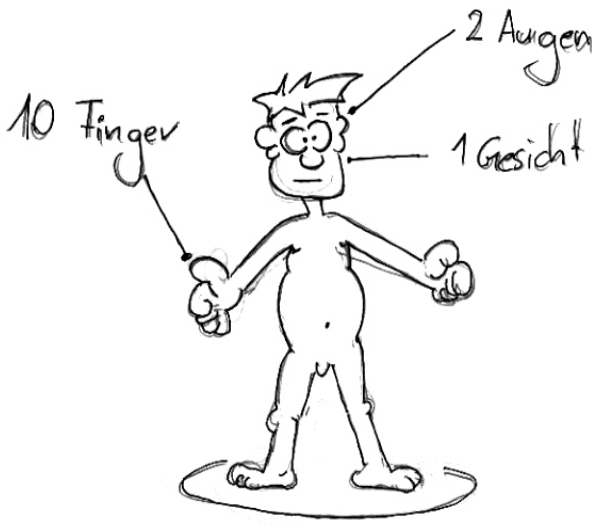
- 3.) PINs can be delegated in violation of the security policy
  - „*This transaction was done by Mr. Popov, who was mis-using my card*“
  - biometric authentication enables non-repudiation of transactions

Biometrics are better than PINs !

Revocability ?

Data subjects may think:

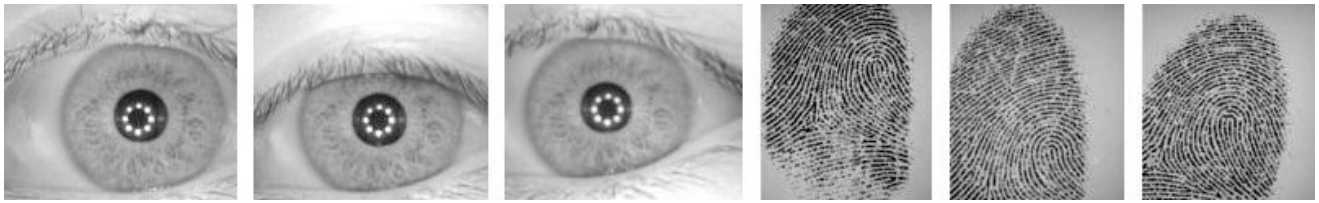
„The number of biometric characteristics is limited (e.g. we have only 10 fingers) - we can not revoke the biometric reference“



Variation of Biometric Measurement ?

Operators may think:

„There is a strong variance in biometric measurements“



Biometric Template Protection

We do NOT store fingerpint, iris or face images

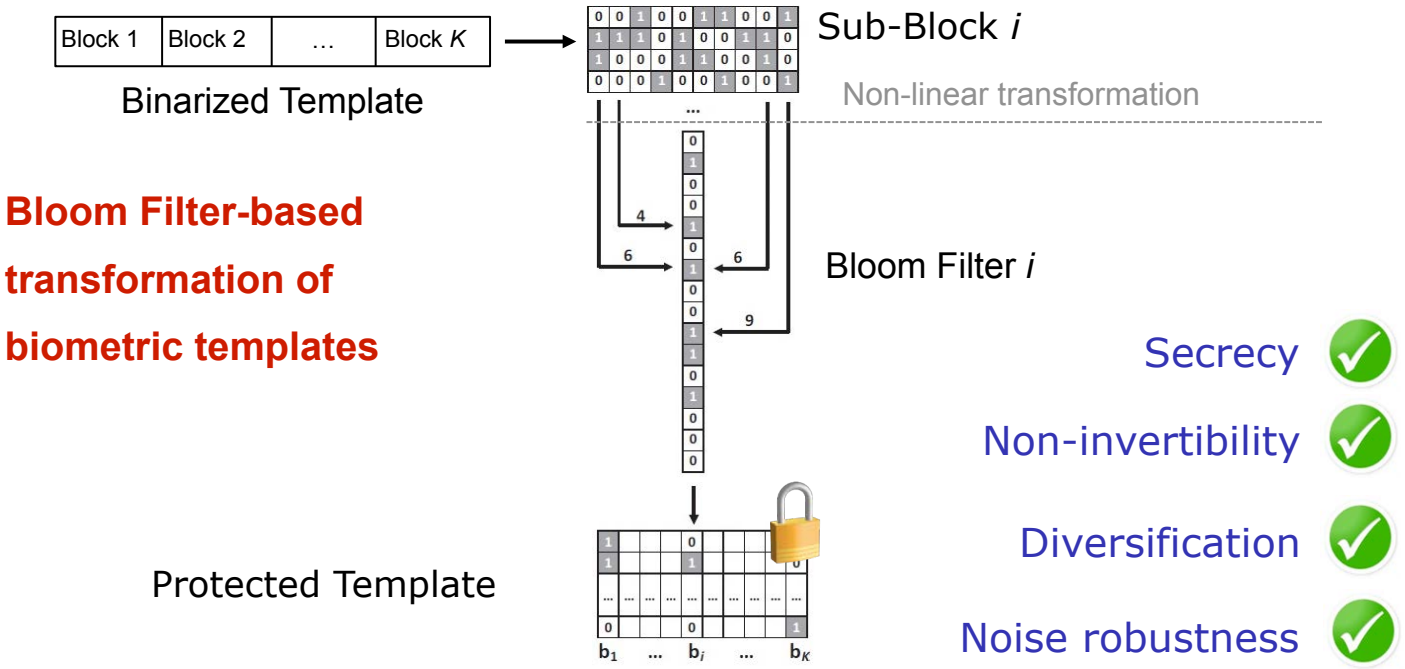
- we transform templates to pseudonymous identifiers (PI)
- we reach
  - Secrecy: biometric references (PI) can be compared without decryption.
  - Diversifiability / Unlinkability: Unique pseudonymous identifier can be created for each application to prevent database cross-comparison
  - Renewability: we can revoke and renew template data.
  - Noise-robustness: Stored information can be used for authentication with noisy biometric samples
  - Non-invertibility:Original biometric sample can not be reconstructed

[Br2008] J. Breebaart, C. Busch, J. Grave, E. Kindt: "A Reference Architecture for Biometric Template Protection based on Pseudo Identities", in BIOSIG-2008, GI-LNI, (2008)
http://www.christoph-busch.de/files/Breebaart-BTPReferenceArchitecture-BIOSIG-2008.pdf

Biometric Template Protection

Protection at the same accuracy level is possible

- Bloom filter-based pseudonymous identifiers



Bloom Filter-based transformation of biometric templates

Secrecy ✓

Non-invertibility ✓

Diversification ✓

Noise robustness ✓

Biometric Template Protection
enables revocability in biometric systems!

Data Privacy and Data Protection ?

Operators may think:

„Biometric systems are not compliant to data privacy principles“

Data Protection Requirements

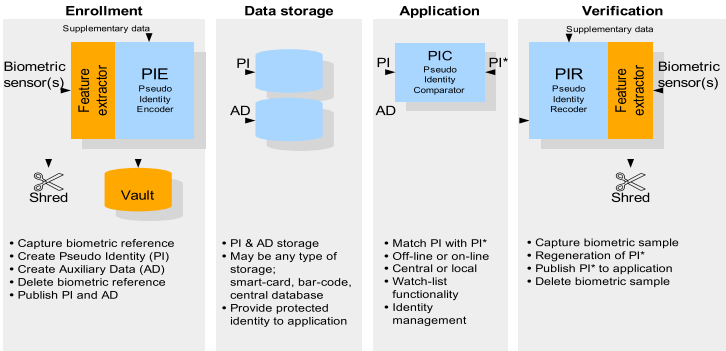
Requirements for data privacy and data protection are formulated in:

- Directive 95/46/EC: On the protection of individuals with regard to the processing of personal data and on the free movement of such data
- EU data protection regulation under development - since 2012
  http://ec.europa.eu/justice/data-protection/document/review2012/com_2012_11_en.pdf
- Regulation 45/2001: on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data
  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:008:0001:0022:en:PDF
- Directive 2002/58/EC: concerning the processing of personal data and the protection of privacy in the electronic communications sector
  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0058:FIN:EN:PDF

Data Protection Requirements

A technical guideline, how to implement requirements for data privacy and data protection is formulated in:

- ISO/IEC 24745: Biometric Information Protection, (2011)
  http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=52946



ISO/IEC 24745
Biometric Information Protection !

Bio-Hacking ?

Operators may think:

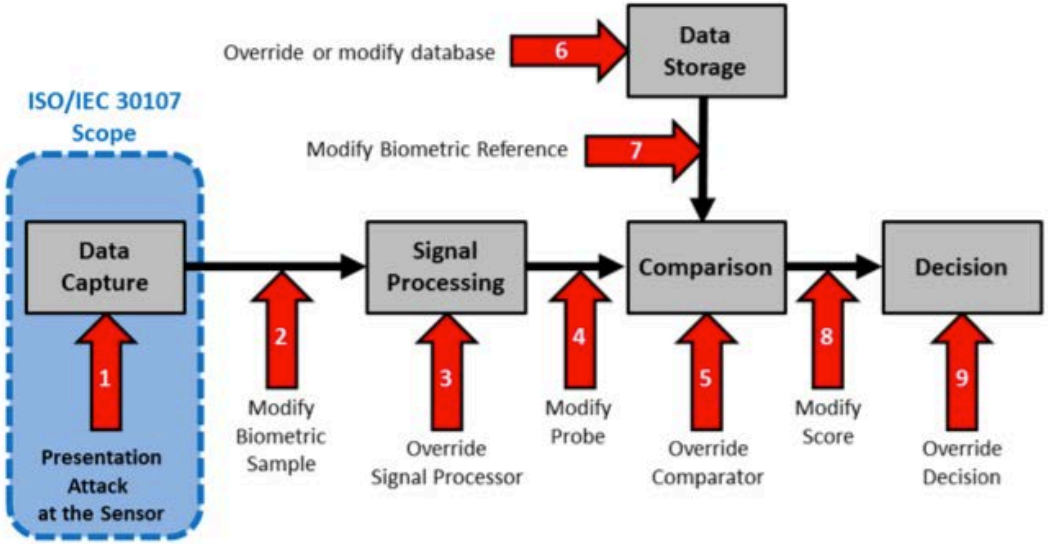
„Biometric sensors can not detect gummy and cut-off fingers“

Presentation Attack Detection

Attacks on capture devices

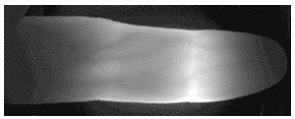
- ISO/IEC 30107 Presentation Attack Detection
  - aka spoof detection

silicon finger



Countermeasures

- Vein recognition

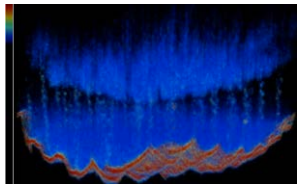


Fingervein image

- Fingerphoto recognition

Half-transparent gelatinwith glycerin

- Fingerprint Recognition with Optical Coherence Tomography (OCT)
  - current research topic



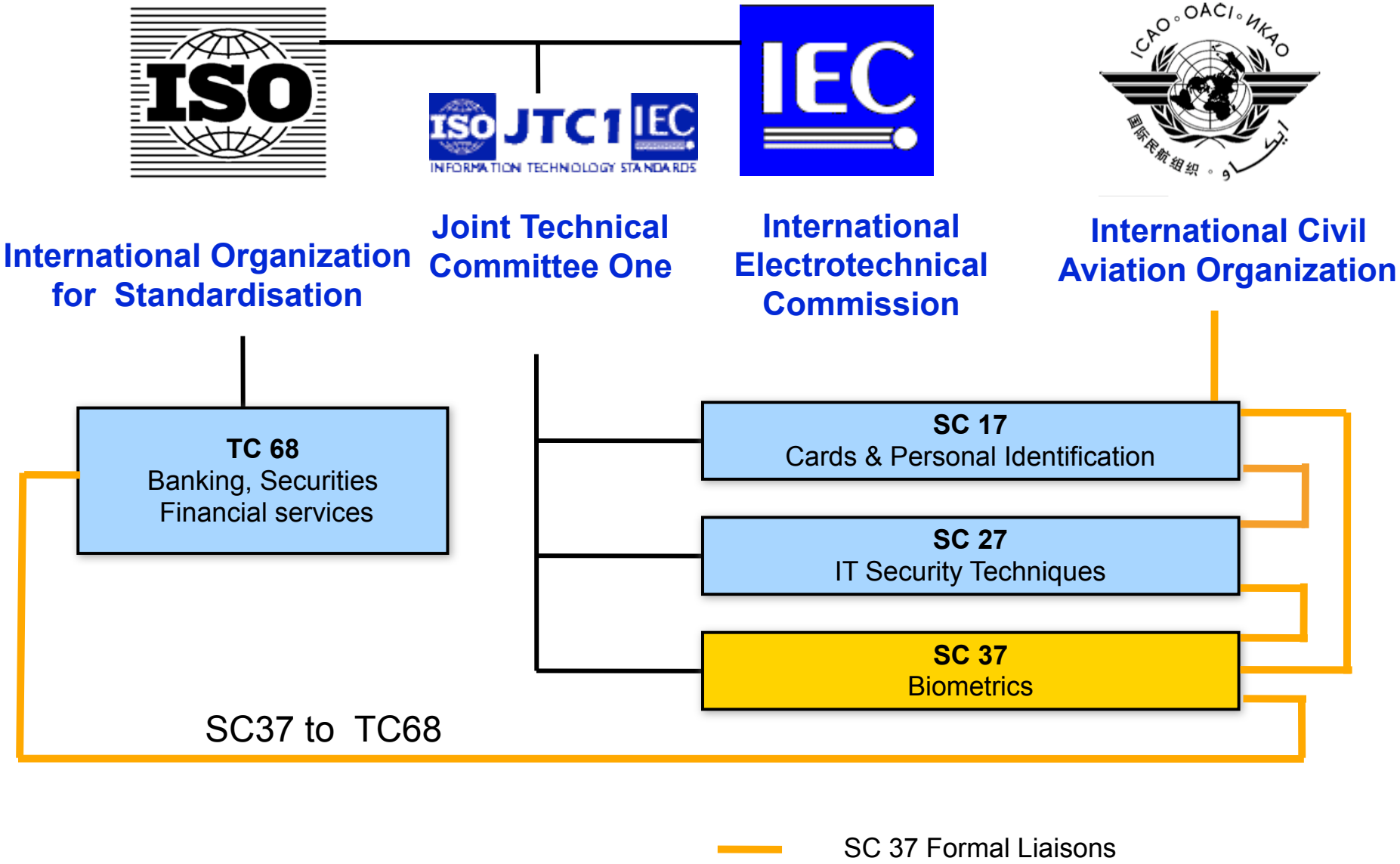
3D Finger OCT scan

Standards ?

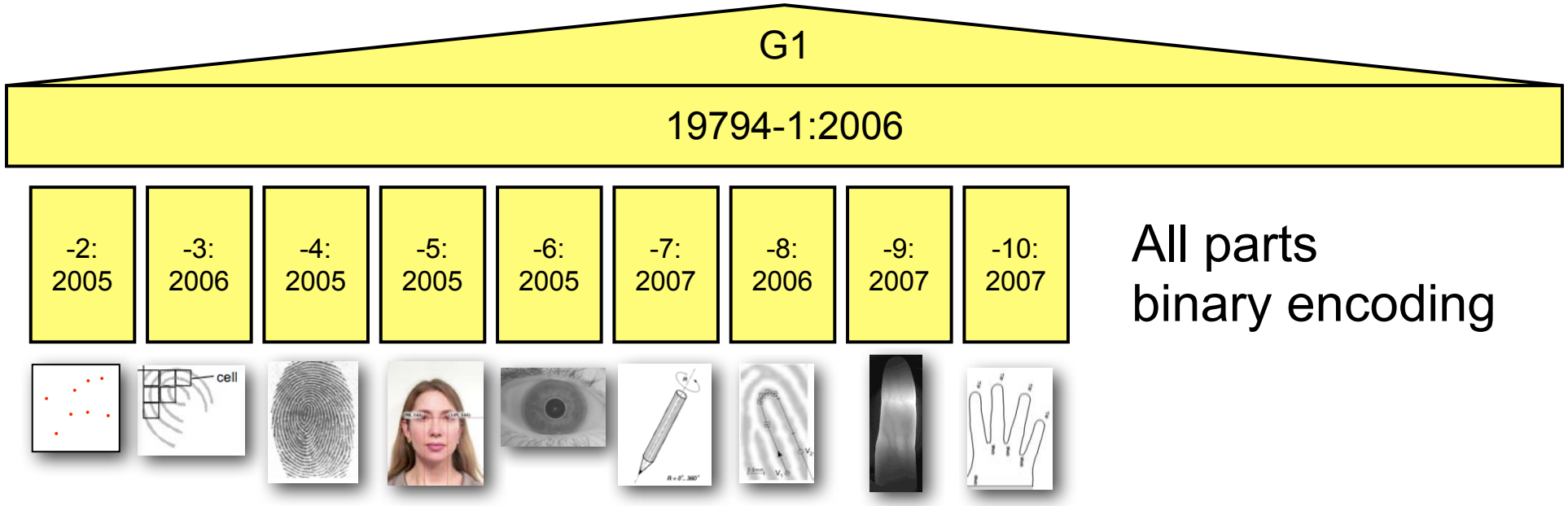
Operators may think:

„*There are no standards on biometrics*“

Biometric Standardisation



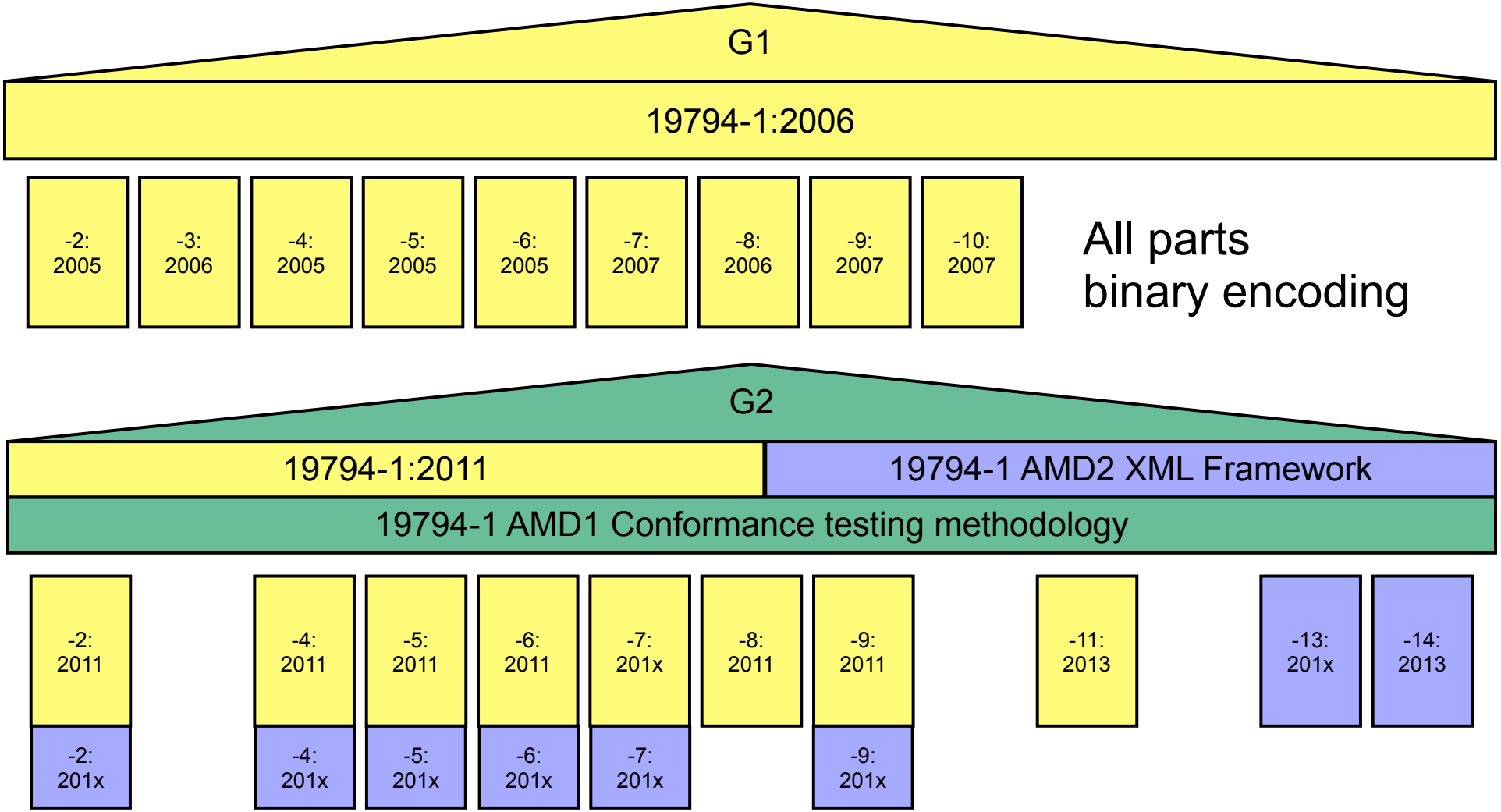
ISO/IEC Interchange Format Standards



All parts
binary encoding

The 19794-Family: Biometric data interchange formats

Generation 2 of ISO/IEC 19794



the semantic is equivalent for binary encoded and XML encoded records

Your Operator Reality Check

Operators should ask the vendors

- Is there a vendor lock-in due to proprietary sensors?

  I want the biometric capture device to be operated via BioAPI interface according ISO/IEC 19784!

- Can comparison algorithms be replaced?

  I want the biometric reference data to be stored in standardised interchange format according ISO/IEC 19794!

- Is the accuracy of the algorithm good?

  I want to see the technology performance test report according ISO/IEC 19795!

- Is there data protection of stored biometric reference data?

  I want the design of the systems to be compliant to ISO/IEC 24745

Mobile Biometrics

Smartphone Access Contol

Foreground authentication (user interaction)

- Deliberate decision to capture (wilful act)
- Camera-Sensor
  - Fingerprint recognition
    - Apples iPhone 5S / Samsung Galaxy 5
    - Fingerphoto analysis
  - Face recognition
  - Iris recognition
- Touchpad: allows signature recognition

Image Source: Apple 2013

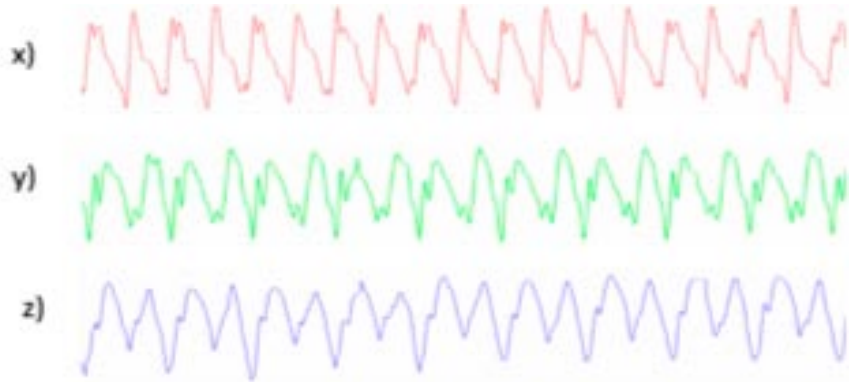
Background authentication (observation of the user)

- Microphone
  - Speaker recogntion
- Accelerometer
  - Gait recognition
  - concurrent - unobtrusive

Biometric Gait Recognition

Offer an unobtrusive authentication method

- Use accelerometers - already embedded in mobile devices to record the gait
  - No extra hardware is necessary
  - Acceleration measured in 3-directions

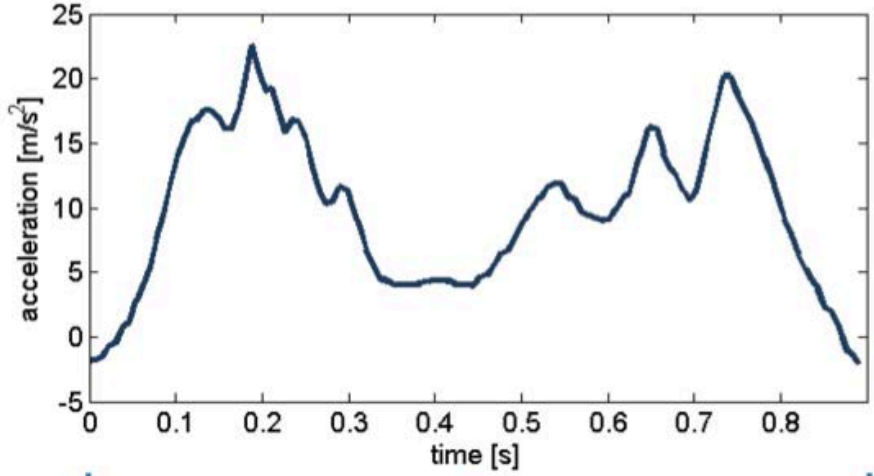


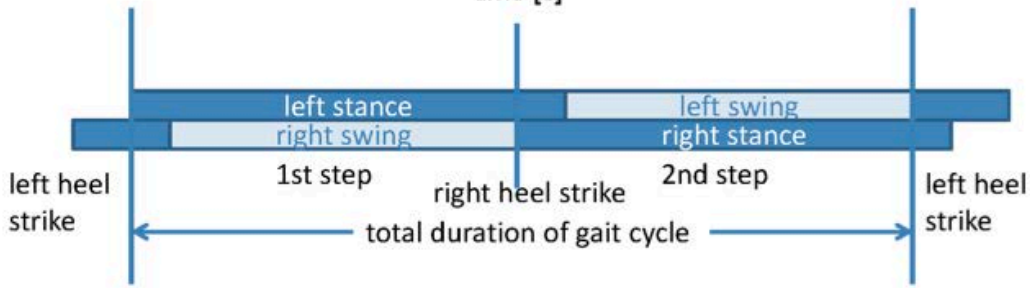
- First paper on this topic:
  [DNBB10] M. Derawi, C. Nickel, P. Bours, C. Busch: „Unobtrusive User-Authentication on Mobile Phones using Biometric Gait Recognition“, Sixth International Conference on Intelligent Information Hiding and Multimedia Signal Processing (IIHMSP 2010)

Biometric Gait Recognition

Data capture process

- periodical pattern in the recorded signal





Best result

- now at 6.1% Equal-Error-Rate (EER)

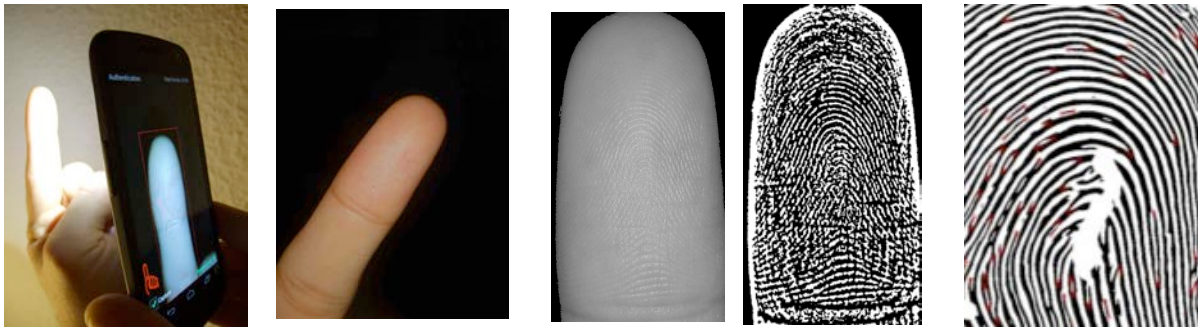
Smartphone Access Contol

Capture process

- Camera operating in macro modus

Preview image of the camera with LED on (left) and LED off (right)

- LED permanent on



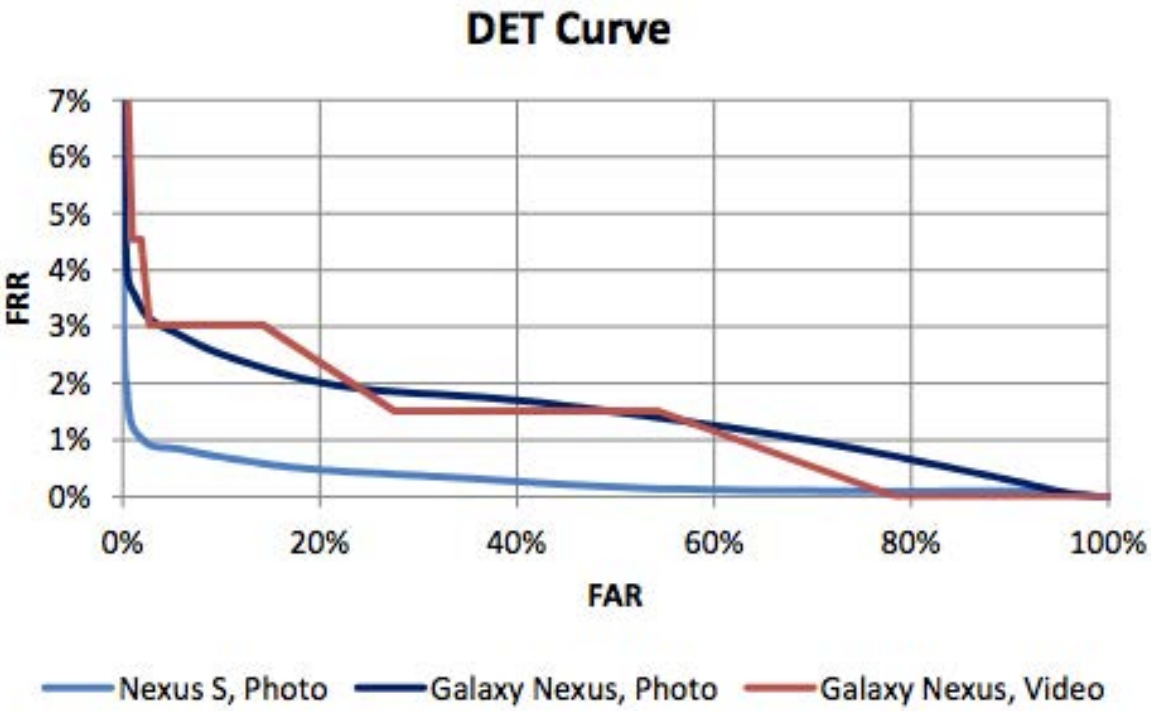
Finger illuminated

[SNB12] C. Stein, C. Nickel, C. Busch, „Fingerphoto Recognition with Smartphone Cameras“, Proceedings 11th Intern. Conference of the Biometrics Special Interest Group (BIOSIG 2012)

Smart Phone Access Contol

Finger recognition study - 2012/2013

- Result: biometric performance at 1.2% EER



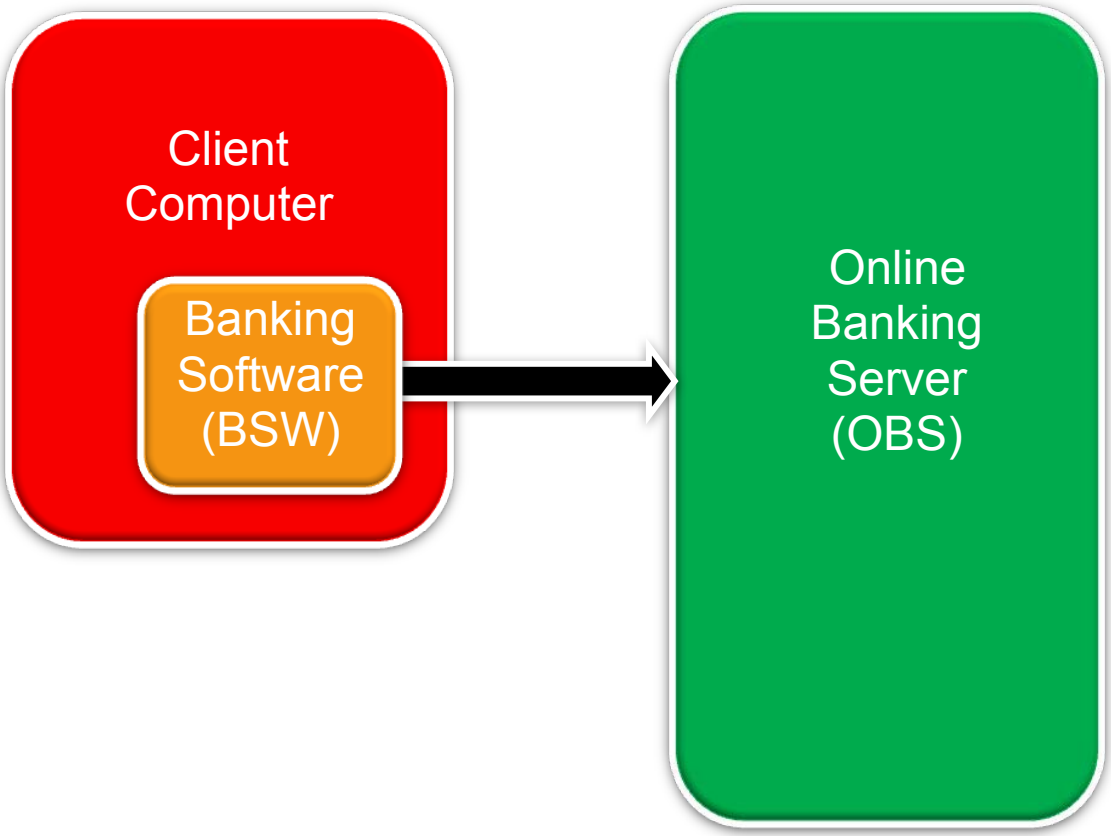
Capture Method and Device	EER from [SC-2012]	EER	FRR (FAR= 0.1%)
Photo, Nexus S	22.3%	1.2%	2.7%
Photo, Galaxy Nexus	19.1%	3.1%	6.7%
Video, Galaxy Nexus	-	3.0%	12.1%

[SBB13] C. Stein, V. Bouatou, C. Busch, „Video-based Fingerphoto Recognition with Anti-spoofing Techniques with Smartphone Cameras“, Proceedings 12th Intern. Conference of the Biometrics Special Interest Group (BIOSIG 2013)

Mobile Biometric Payment - Biometric Transaction and Authentication Protocol (BTAP)

Online-Banking-Scenario

Elements in the Online-Banking-Scenario:



Transaction-Authentication-Protocol

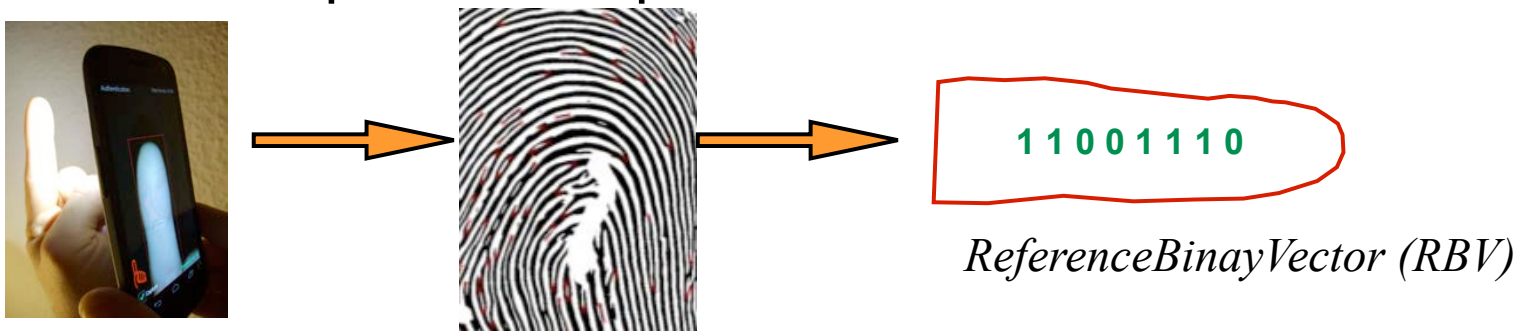
Biometric Transaction Authentication Protocol (BTAP)

1.) Shared secret

- received via subscribed letter from the bank
- entered once to the smartphone
  - hash over the secret constitutes a Pseudonymous Identifier (PI)

2.) Biometric enrolment

- Biometric samples are captured

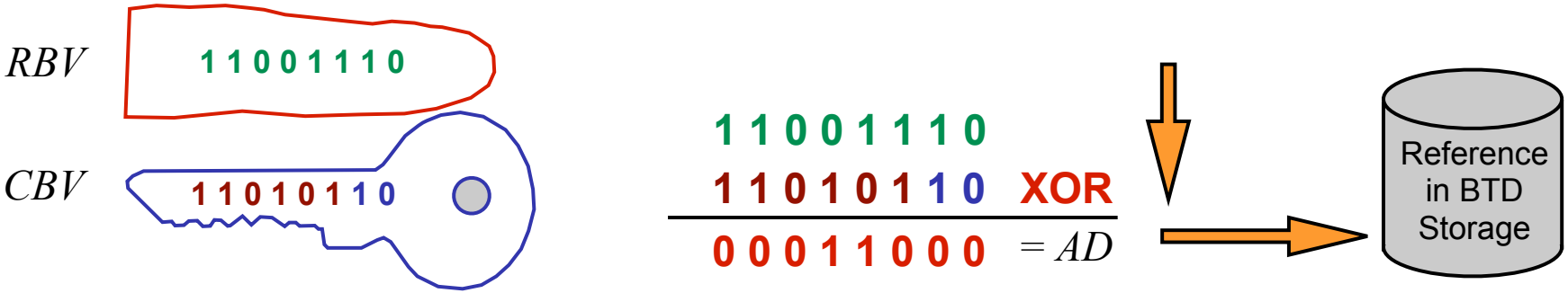


Transaction-Authentication-Protocol

Biometric Transaction Authentication Protocol (BTAP)

3.) Secure storage of auxilliary data

- we neither store the confidential secret nor the sensitive biometric data (i.e. feature vector)
- the secret and biometric data are merged



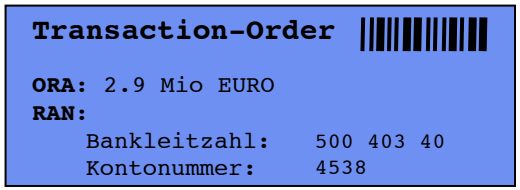
- Auxilliary data (AD) stored in the Smartphone
  - Biometric Transaction Device = FIDO Authenticator

Transaction-Verification

BTAP - Transaction

1.) Operations of the Online-Banking-Software (BSW)

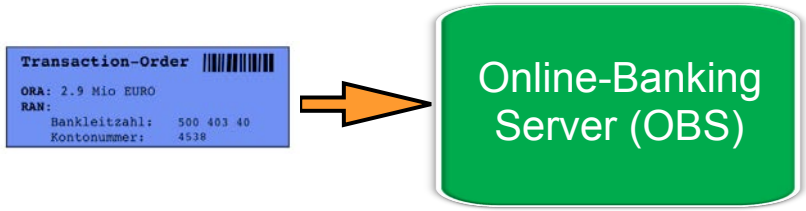
- Customer generates by interacting with the BSW-Software a new Transaction-Order-Record (TOR)



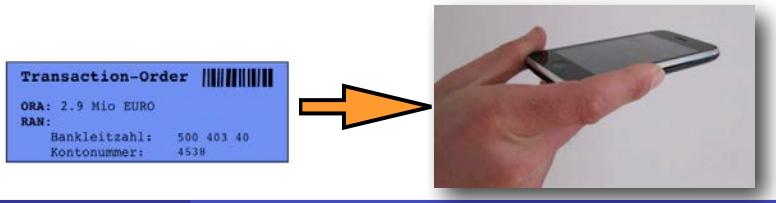
  This TOR consist of:

  - Transaction-Identifier (TID), Sender-Account-Number (SAN) Receiver-Account-Number (IBAN), Ordered Amount (ORA)

- BSW transfers TOR to the Online-Banking-Server (OBS)



- BSW transfers TOR to Smartphone (BTD / FIDO Authenticator)

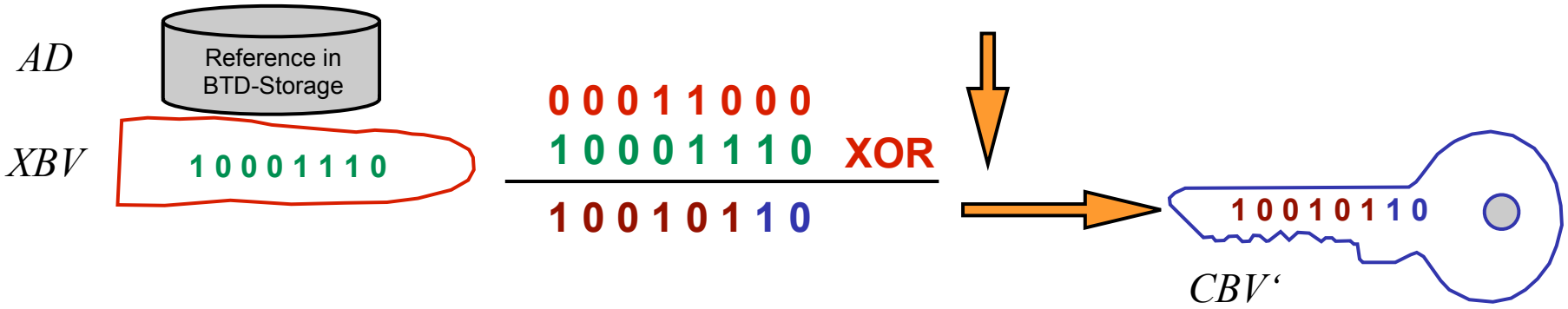


Transaction-Verification

BTAP - Transaction

2.) Operations on the Smartphone (BTD)

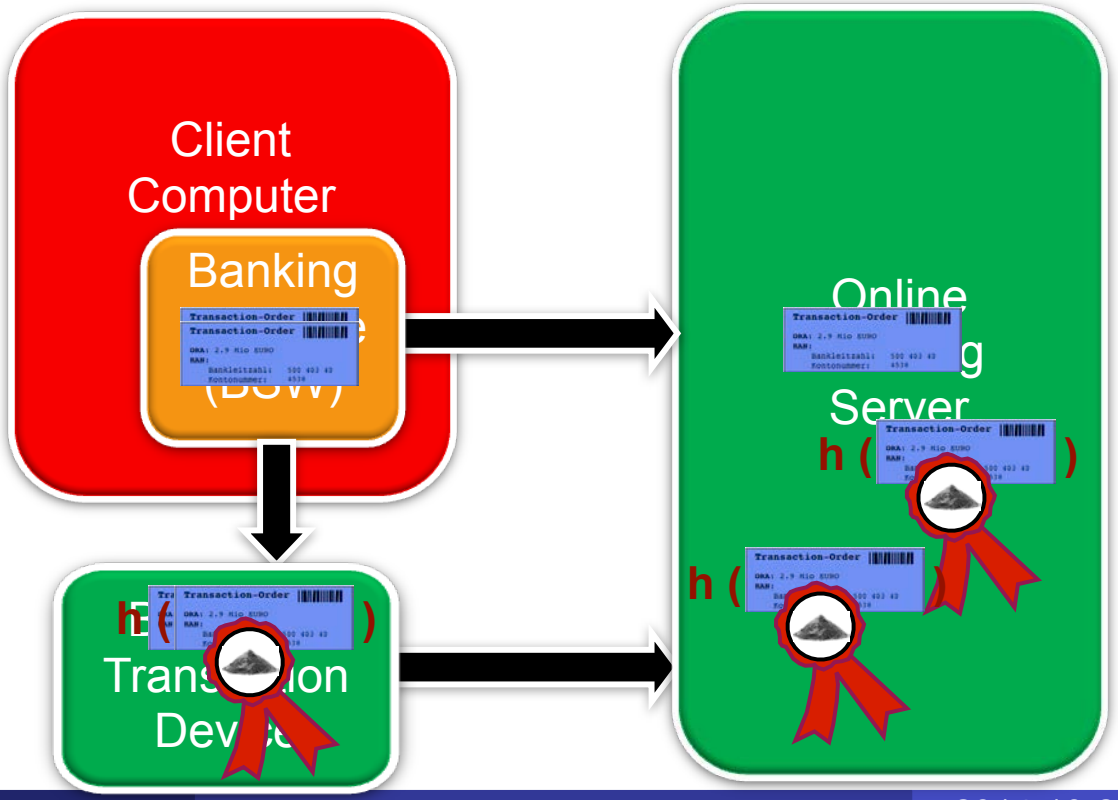
- Approval of the intended transaction by capturing a probe sample
- A secret vector CBV' is reconstructed with XOR operation from the Auxilliary Data AD that was stored in the BTD and from the binarized feature vector XBV



Transaction-Verification

Key features of BTAP

- independent two channel verification
- reconstruction of shared secret
- the Pseudonymous Identifier (PI) constitutes a seal
- seal operation over the TOR to authenticate the transaction



Conclusion

Biometrics is possible with todays smartphones

- a biometric authentication factor is a good choice with respect to security threats

Biometric standards are available

- financial transaction schemes should follow technical standards
- financial transaction schemes should follow privacy standards

BTAP follows the two channel concept

- is based on international ISO/IEC standards
- is privacy friendly as no biometric reference is stored on a banking server

More and detailed information on BTAP at:

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

Contact


CASED
h_da
HOCHSCHULE DARMSTADT
UNIVERSITY OF APPLIED SCIENCES
Prof. Dr. Christoph Busch
Principal Investigator
CASED
Mornewegstr. 32
64293 Darmstadt/Germany
christoph.busch@cased.de
Telefon +49 6151/16 9444
Fax
www.cased.de

Contact


HØGSKOLEN I GJØVIK
GJØVIK UNIVERSITY COLLEGE
FACULTY OF COMPUTER SCIENCE AND MEDIA TECHNOLOGY
Christoph Busch, Dr.-Ing.
Professor
P.O. Box 191, N-2802 Gjøvik, Norway
Phone: +47 61 13 51 94
Fax: +47 61 13 52 40
E-mail: christoph.busch@hig.no
www.hig.no | www.nislab.no