



Biometric Standards

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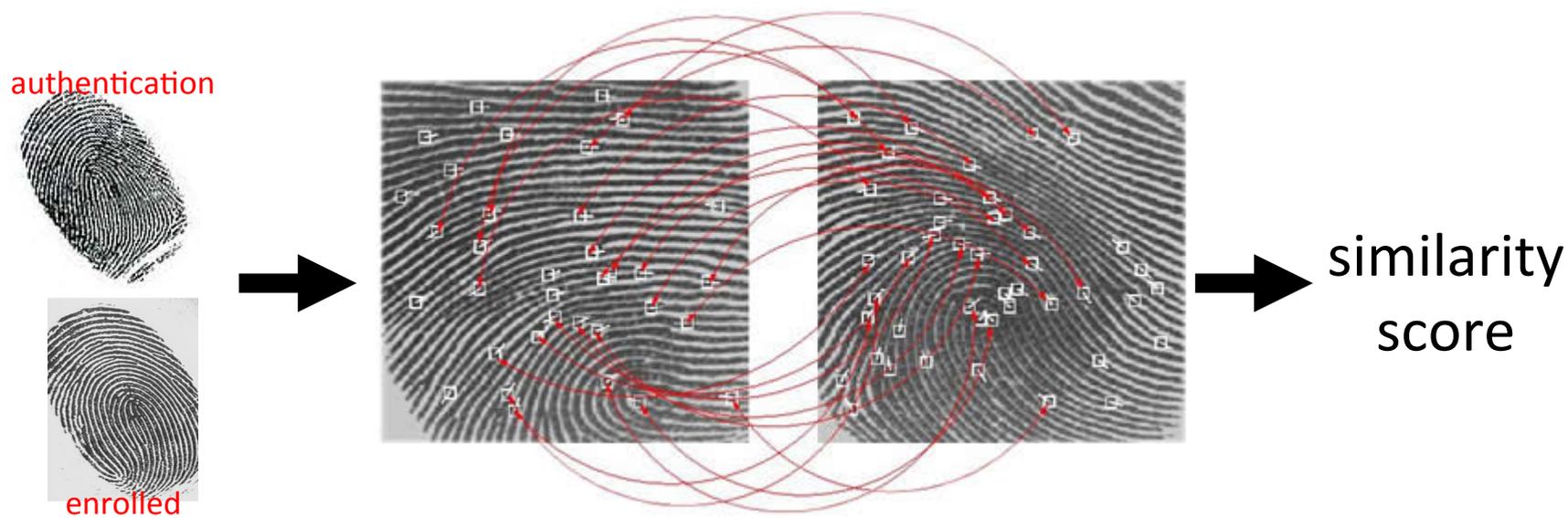
BIOMETRIC



Without standards, a technology cannot become ubiquitous, particularly when it is part of a larger network.

The Economist - 8 May 2003.

Biometric comparison algorithm



- higher similarity scores construed to indicate higher likelihood that the samples come from the same individual.
- Input can be image or a template (i.e. features extracted from an image) which can either be proprietary or standard (e.g. ISO/IEC 19794-2, INCITS 378, ANSI/NIST Type 9).

Why [Biometric] Standard

- » Open specifications for exchange of biometric data.
- » Prevent vendor lock-in.
- » Allows for a marketplace of off-the-shelf product.
- » Allows modular integration of products without comprising architecture scope.
 - Reduce cost of technology refresh
- » Allows for performance improvement (quality by design)
 - Prevent GIGO

Improve acquisition quality by compliance to standard



Ghost image

Cause: residual fingerprint -
unclean scanner

Action: Prompt operator to clean
the surface of the scanner



Partial Image

Cause: Poor presentation or
segmentation failure

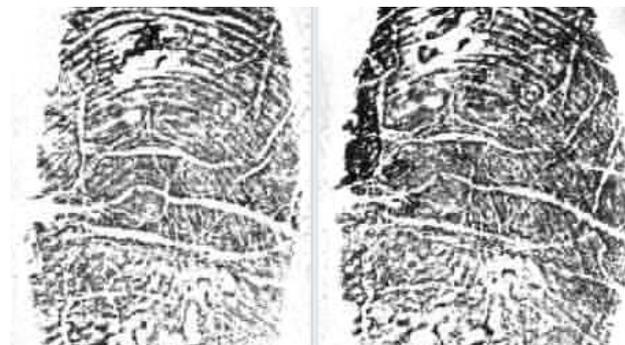
Action: Prompt for re-capture or
check segmentation alg.



Low overlap

Cause: Poor presentation/capture

Action: Recapture with finger
centered

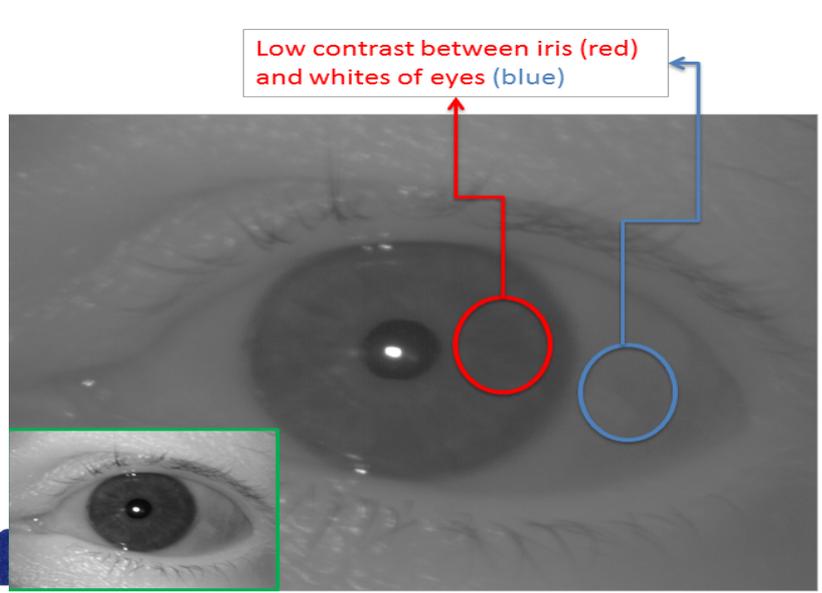
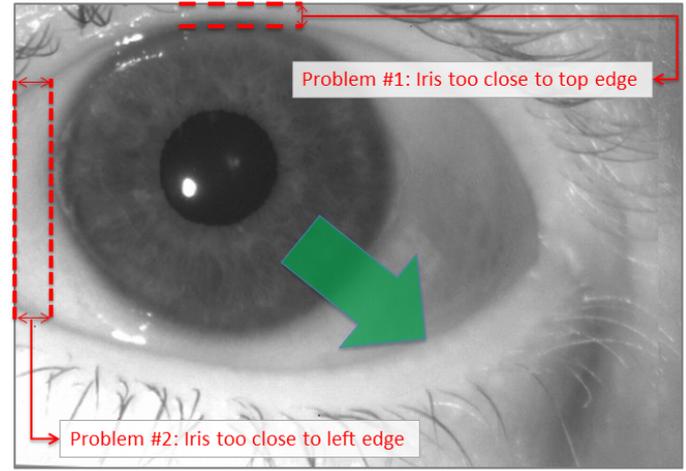
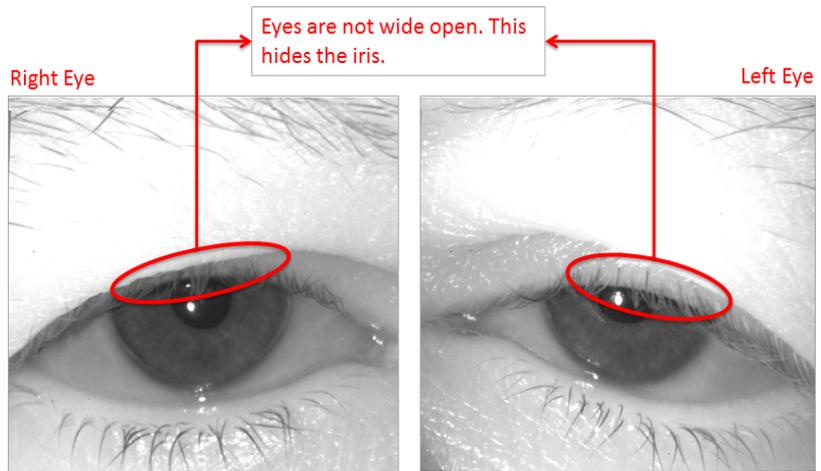


High noise – low or no signal

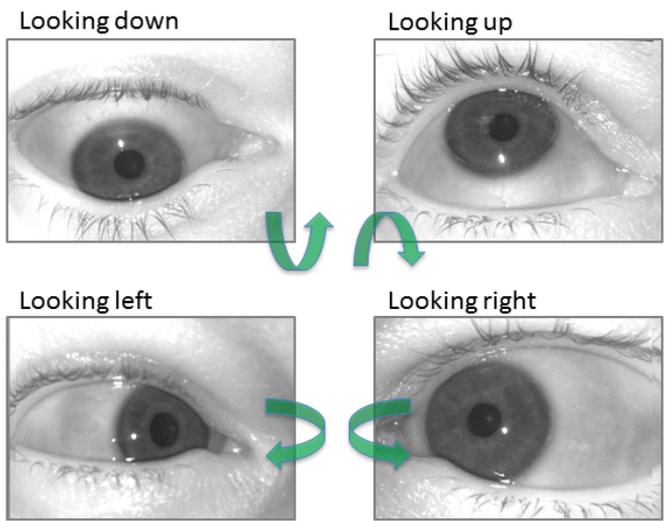
Cause: Low character or noise

Action: clean the finger+scanner. Recapture. If no
success, move to another finger/modality.

Improve acquisition quality by compliance to standard



Subject is not looking into the camera.



Why Standards

Highlights of a study by DIN (German Standards Institute) and the German Federal Ministry of Economic Affairs and Technology (IEEE Think Standards, <http://www.thinkstandards.net/benefits.html>)

- » Standards contribute more to economic growth than patents and licenses
- » Standards play a strategic significance to companies
- » Companies that participate actively in standards work have a head start on their competitors in adapting to market demands
- » Research risks and development costs are reduced for companies contributing to the standardization process
- » Business that are actively involved in standards work more frequently reap short and long term benefits with regard to costs and competitive status than those who do not participate
- » Participating in standards development enables one to anticipate technology standardization thereby facilitating one's products progress simultaneously with technology
- » Standards are a positive stimulus for innovation

UIDAI Adoption of biometric standards

ISO/IEC 19794

Biometric data interchange format

- Part 2 - Finger minutiae
- Part 4 – Finger image
- Part 5- Face image
- Part 6 – Iris image

ISO/IEC 19785

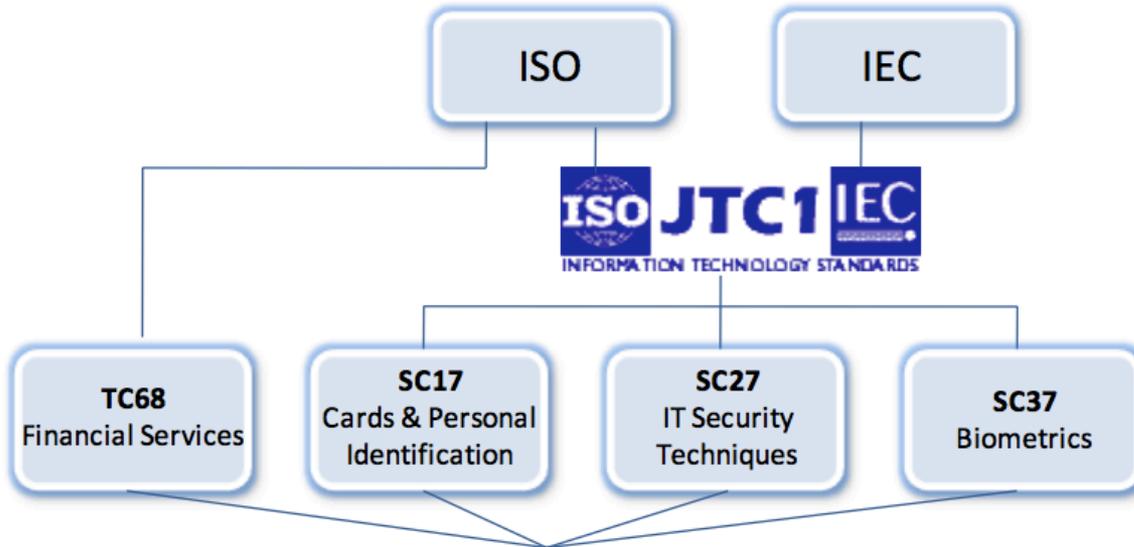
Common Biometric Exchange Formats Framework (CBEFF)

- for packaging the biometric data,
- providing common structure, metadata, and security.

After reviewing international standards and current national recommendations, the Committee concluded that the ISO 19794 series of biometrics standards for fingerprints, face and iris set by the International Standards Organization are the most suitable. -- Biometrics Design Standards for UID Applications.

http://uidai.gov.in/UID_PDF/Committees/Biometrics_Standards_Committee_report.pdf

[Biometrics] Standard Development Organization



National Bodies



NIST Special Publication 500-200
Rev1 (2013)

Information Technology:
American National Standard for Information Systems



Data Format for the Interchange of Fingerprint, Facial
& Other Biometric Information
ANSI/NIST-ITL 1-2011 Update:2013
Incorporating
ANSI/NIST-ITL 1-2011 Sup:Digital & ANSI/NIST-ITL 1-2011 Sup:Voice
with additional new material

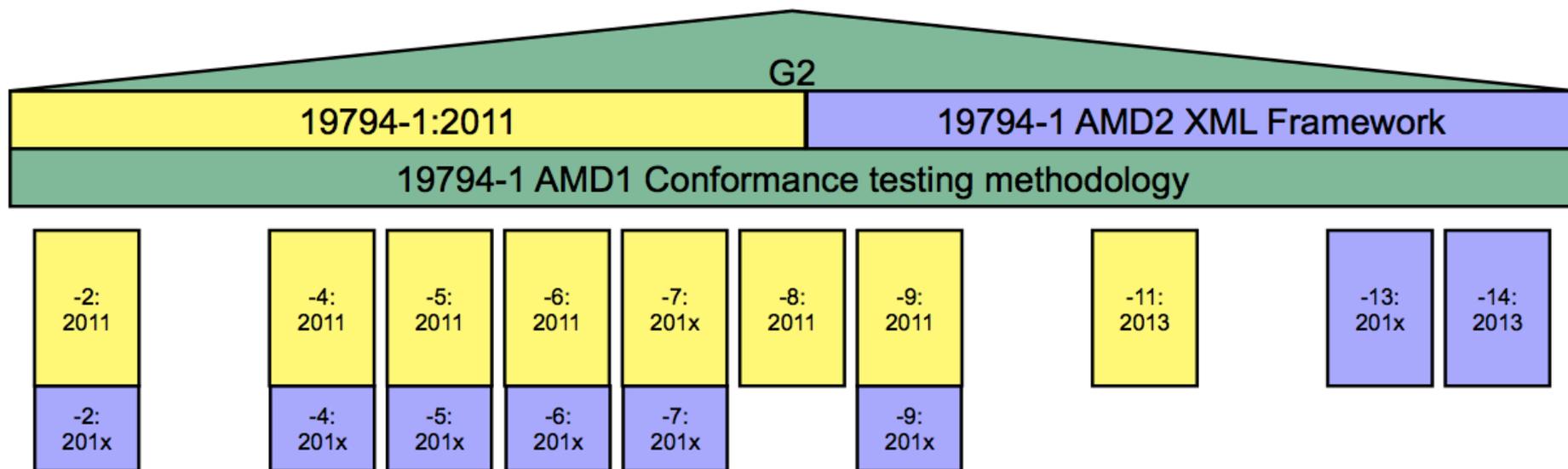
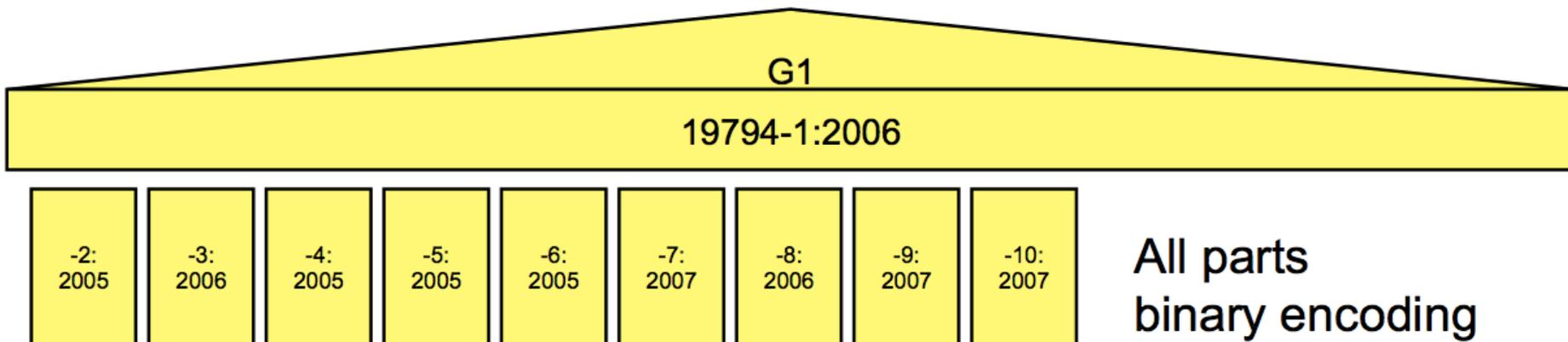


ANSI/NIST

- » National
- » Established Technical Committee M1, Biometrics, in June 2001
- » 31 member
- » M1 serves as the U.S. Technical Advisory Group for ISO/IEC JTC 1 SC 37
- » INCITS M1 meets 5 times a year
- » End users: Commercial and civilian applications – e.g. PIV
- » International
- » Established Sub Committee 37 Biometrics in Nov. 2002 (and has been very busy)
- » 28 national body + 10 observer
- » 6 working groups (Vocabulary + Interfaces + Data Formats + Profiles + Testing + Societal)
- » SC 37 meets twice a year
- » End users: Commercial and civilian applications – e.g. Indian UID, ICAO e-passport

Biometric standards have been the foundation of cross-agency, cross-vendor interoperability and the basis of federated identity management.

ISO/IEC SC 37 WG 3 Biometric data formats



the semantic (i.e. general header / structure of representation header) equivalent for binary encoded and XML encoded parts in G2

ISO/IEC SC 37 WG 3 – Data Formats 1st generation

1st Generation [G1]

Title	Format-Standard	State after US	Publication	CT-Standard	State after US	Publication
Framework	19794-1:2006	IS	2006	29109-1	IS	2009
				29109-1 COR1	COR	2010
Finger minutiae data	19794-2:2005	IS	2005	29109-2	IS	2010
Technical Corrigendum	19794-2:2005 COR1	COR	2009			
Detailed Description of Finger Minutiae location, Direction and Type	19794-2:2005 AMD1	AMD	2010			
Technical Corrigendum - OnCardComparison-Example in AMD 1	19794-2:2005 COR2	The DTC has been approved with no comments.	?			
Level 3 Conformance Testing for Minutiae Data				29109-2 AMD1		
Finger pattern spectral	19794-3:2006	IS	2006	29109-3	withdrawn	withdrawn
Finger image data	19794-4:2005	IS	2005	29109-4	IS	2010
	19794-4:2005 COR1	COR	2011	29109-4 COR1	COR	2011
Face image data	19794-5:2005	IS	2005	29109-5:2011	IS	2011
	19794-5:2005 COR1	COR	2008	29109-5:2012	IS	2012
	19794-5:2005 COR2	COR	2008	29109-5:2014	IS	2014
Technical Corrigendum-Modulo2	19794-5:2005 COR3	COR	2013			
Conditions for taking photographs for face image data	19794-5:2005 AMD1	AMD	2007			
Three-dimensional face image data interchange format	19794-5:2005 AMD2	AMD	2009			
Iris image data	19794-6:2005	IS	2005	29109-6	IS	2011
Signature/sign time series data	19794-7:2007	IS	2007	29109-7	IS	2011
	19794-7:2007 COR1	COR	2009			
Finger pattern skeletal data	19794-8:2006	IS	2006	29109-8	IS	2011
	19794-8:2006 COR1	DCOR	2011			
Vascular image data	19794-9:2007	IS	2007	29109-9	IS	2011
Hand geometry silhouette data	19794-10:2007	IS	2007	29109-10	IS	2010

ISO/IEC SC 37 WG 3 – Data Formats 2nd generation

2nd Generation [G2]

Title	Format-Standard	State after US	Publication	CT-Standard	State after US	Publication
Framework	19794-1:2011	IS	2011	19794-1:2011 AMD1	AMD	2013
Framework for XML encoding	19794-1:2011 AMD2	FDAM	?	19794-1:2011 AMD2 Annex CT		
Finger minutiae data	19794-2:2011	IS	2011	19794-2:2011 AMD1	AMD	2013
Editorial Corrigendum-OID	19794-2:2011 COR1	COR	2012			
Technical Corrigendum-CoreDelta-for-On-Card-Comparison	19794-2:2011 COR2	DCOR implemented with draft AMD2				
Finger minutiae data - XML	19794-2:2011 AMD2 PDA	DAM	?	19794-4:2011 AMD2 Annex CT		
Finger pattern spectral						
Finger image data	19794-4:2011	IS	2011	19794-4:2011 AMD1	AMD	2013
Editorial Corrigendum-OID	19794-4:2011 COR1	COR	2012			
		comment in DAM the open				
Technical Corrigendum-compression type	19794-4:2011 COR2	ballot on AMD1	2013			
Finger image data - XML	19794-4:2011 AMD2	DAM	?	19794-4:2011 AMD2 Annex CT	DAM	
Face image data	19794-5:2011	IS	2011	19794-5:2011 AMD1	AMD	2014
		DCOR implemented with				
Technical Corrigendum-Modulo2+OID	19794-5:2011 COR1	draft AMD1	2014			
		DefectReport implemented				
Editorial Corrigendum-MPEGLandmarks	19794-5:2011 COR2	with draft AMD1	2014			
Face image data - XML	19794-5:2011 AMD2	DAM	?	19794-5:2011 AMD2 Annex CT		
Iris image data	19794-6:2011	IS	2011	19794-6:2011 AMD1	DAM	?
Editorial Corrigendum-OID	19794-6:2011 COR1	COR	2012			
Iris image data - XML	19794-6:2011 AMD2	2nd PDAM	?	19794-6:2011 AMD2 Annex CT		
Signature/sign time series data	rev19794-7	IS	2014	rev19794-7 Annex CT		
Signature/sign time series data - XML	rev19794-7 AMD1	DAM	?	rev19794-7 AMD1 Annex CT		
Finger pattern skeletal data	19794-8:2011	IS	2011	19794-8:2011 AMD1	AMD	2014
Editorial Corrigendum-OID	19794-8:2011 COR1	COR	2012			
		Defect implemented with				
Editorial Corrigendum-typo	19794-8:2011 COR2	draft AMD1	2014			
Vascular image data	19794-9:2011	IS	2011	19794-9:2011 AMD1	AMD	2013
Editorial Corrigendum-OID	19794-9:2011 COR1	COR	2012			
Vascular image data - XML	19794-9:2011 AMD2	DAM	?	19794-9:2011 AMD2 Annex CT		
Hand geometry silhouette data						
Signature/sign processed dynamic data	19794-11:2013	IS	2013	19794-11 AMD1	AMD	?
Voice data	19794-13	CD	?	19794-13 AMD1		?
DNA data	19794-14:2013	IS	2013	19794-14 AMD1	5th PDAM	?
Palm crease image data	19794-15:201x	2nd WD	?			

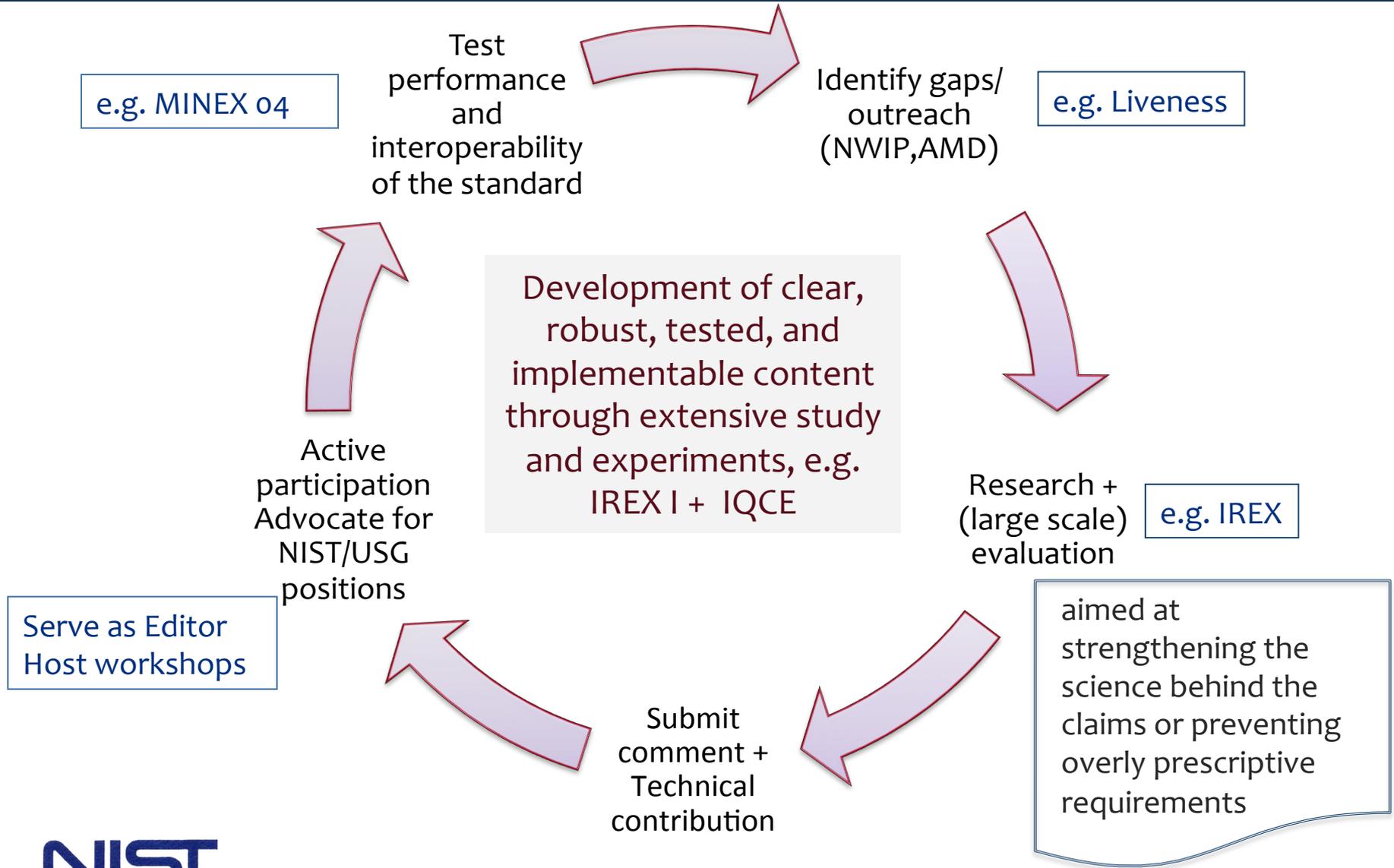
ISO/IEC SC 37 WG 3 – Fusion, Quality, Live-ness

Title	BASE-Standard	State after US	Publication
Biometric Calibration and Fusion Data			
Fusion information format	29159-1	IS	2010
Biometric Sample Quality			
Framework	29794-1:2009	IS	2009
Framework	rev29794-1	DIS	?
Finger image data	29794-4:2010	TR	2010
Finger image data	rev29794-4	4th WD	?
Face image data	29794-5	TR	2010
Iris image data	29794-6	FDIS	?
Presentation Attack Detection			
Framework	30107-1	2nd CD	
Data formats	30107-2	2nd WD	
Testing, Reporting and Classification of Attacks	30107-3	2nd WD	

Our contribution/participation

- » Active participation
 - Editor or Co-editor of 20 work items
- » Provide *quantitative support* to the development of standards
 - To assure developed standards are clear, robust, implementable
 - By running large scale studies and evaluations
 - E.g., MINEX, IREX, IQCE
- » Goal: better performance by compliance to standard
 - Inclusion of semantic meta data (i.e. quality related clauses)

Technical Approach :: provide quantitative support



Finger image data exchange

ISO/IEC 19794-4

- Specifies image based encoding of one or more finger images or palm image areas
- **Maximum retention of information** from the biometric source
- Highest level of interoperability
 - No dependability on the comparison algorithm
- The information consists of a variety of mandatory and optional items, including scanning parameters, compressed or uncompressed images and vendor-specific information



General Header	Format identifier	Version number	Length of record	Number of finger/palm representations	Certification flag	Number of distinct finger/palm positions
	4	4	4	2	1	1

Representation Header	Representation length	Capture date & time	Capture device technology identifier	Capture device vendor identifier	Capture device type identifier	Number of quality blocks
	4	9	1	2	2	1

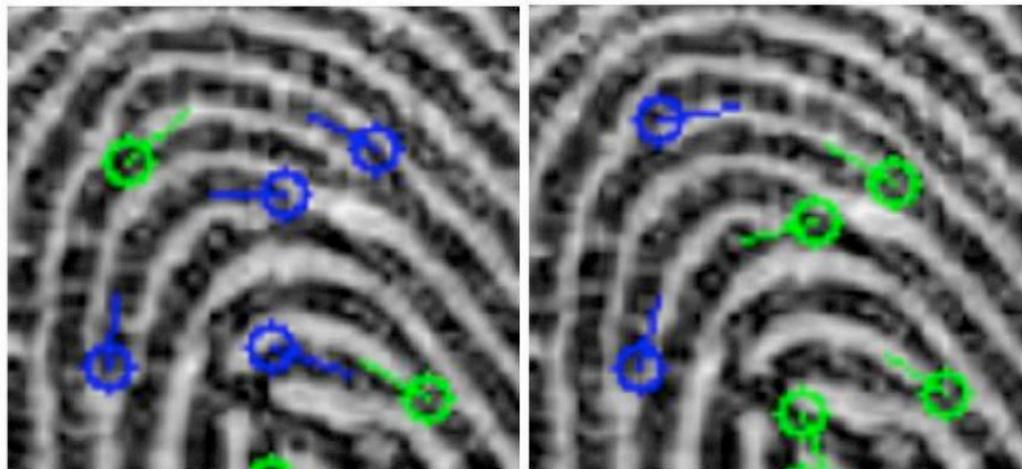
Quality block data	Number of certification blocks	Certification block data	Finger/palm position	Representation number	Scale units	Capture device spatial sampling rate (horiz)	Capture device spatial sampling rate (vert)
5x	0 or 1	3x	1	1	1	2	2

Image spatial sampling rate (horiz)	Image spatial sampling rate (vert)	Bit-depth	Image compression algorithm	Impression type	Horizontal line length	Vertical line length	Image data length
2	2	1	1	1	2	2	4

Finger minutiae data exchange

ISO/IEC 19794-2

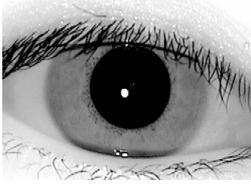
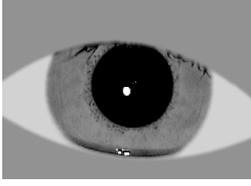
- Encoded **information**
 - Minutia **coordinates** (x,y)
 - Minutia direction (**angle** θ)
 - Minutia **type** (ridge bifurcation and ridge endings, others)
- Extended information
 - Ridges count + Core and delta location
 - Zonal quality + vendor-defined extended data



Iris image data exchange

ISO/IEC 19794-6

- » specifies iris image interchange formats for biometric enrolment, verification and identification systems.
 - Image format
 - Compression format for size constrained applications
- » Compression Formats
 - lossless compression (PNG and JPEG2000) or lossy compression (JPG2000)
 - Allows for compact iris image (as low as 2000 bytes)

	Type 1 Uncropped	Horiz Margin $\geq 0,6R$ Verti Margin $\geq 0,2R$
	Type 2 VGA	Horiz Margin $\geq 0,6R$ Verti Margin $\geq 0,2R$ W = 640, H = 480
	Type 3 Cropped	Horiz Margin = $0,6R$ Verti Margin = $0,2R$
	Type 7 Cropped + Masked	Horiz Margin = $0,6R$ Verti Margin = $0,2R$

Questions?

THANKS

BIOMETRIC DATA FORMAT



Why biometric standards?

Biometric standards play a critical role in the adoption and successful implementation of biometrics in applications where interoperability and interchangeability are needed. For biometrics to be used effectively, they must be exchanged. That exchange may only be between the capture device and a local resource or it could be between a collection system and a backend matching system or data interchange between systems, agencies, or governments. To support data exchange in a heterogeneous environment, standards are required to achieve interoperability. To integrators and end users, open standards are a way to reduce cost, schedule, and technical risks and to avoid "vendor lock-in" issues. Approximately, \$1.5 (US) billion is invested globally each year in the creation and management of standards. -- IEEE Think Standards. Standards contribute more to economic growth than patents and licenses. -- German institute for standardization -- DIN.

Without standards, a technology cannot become ubiquitous, particularly when it is part of a larger network. *The Economist* - 8 May 2003.

USG and Biometric Standards

NSTC POLICY FOR ENABLING THE DEVELOPMENT, ADOPTION AND USE OF BIOMETRIC STANDARDS

USG agencies should continue to provide administrative and technical leadership for national and international biometric standards development, and should coordinate USG positions and contributions to these standards developers through the Subcommittee.

The National Biometrics Challenge identifies biometric systems interoperability as one of four pre-eminent challenges for the biometrics community, and identifies the following standards-based role for the Federal government: "Participate in biometrics open standards development, standards adoption, conformance test tool development, conformity assessment system development, and harmonization of biometrics, security and authentication standards."

What we do

Provide quantitative support to development of clear, robust, tested, sufficient and implementable biometric data exchange formats, biometric sample quality, biometric acquisition and processing protocols, and conformance testing methodologies standards (e.g., WSQ) that reflect the operational needs of U.S. government, including open source reference implementations, standard reference datasets and technical reports/guidance.

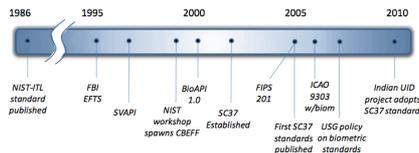
http://www.nist.gov/itl/iad/jg/biometric_standards.cfm

Adaptation of biometric standards

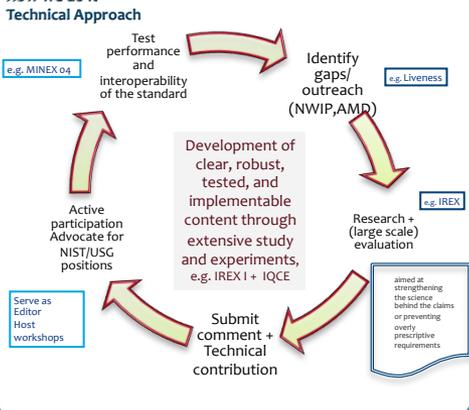
- I. HSPD-12 -- Policy for a Common Identification Standard for Federal Employees and Contractors
 - o INCITS, ANSI/NIST ITL data format
- II. ICAO's (International Civil Aviation Organization, a UN agency) machine readable travel documents (MRTDs) such as ePassports and eVisas.
 - o JTC + SC 37 data format
- III. The Unique Identity Authority of India (UIDAI) Aadhaar project
 - o JTC + SC 37 data format



Timeline of biometric standards



How we do it



NIST ITL IAD Role and Contribution to ISO/IEC Joint Technical Committee + Subcommittee 37 (Biometrics)

- o Active participation
 - Editor or Co-editor of 20 work items ISO/IEC SC37 draft document working items representing various parts of five major international biometric standards: biometric data interchange formats, the conformance testing of biometric data interchange formats, biometric sample quality, biometric performance testing and reporting, and data formats for biometric testing and reporting.
- o Provide quantitative support to the development of standards
 - To assure developed standards are clear, robust, implementable
 - By running large scale studies and evaluations
- o Goal: better performance by compliance to standard
 - Inclusion of semantic meta data (i.e. quality related clauses)



Snap shot of Standards in ISO/IEC Joint Technical Committee + Subcommittee 37 (Biometrics) Working Group 3 (Data Formats)

ISO Generation (G1)	Title	Formal-Standard	State after TR	Open after TR	Final	Published	Publication	CT-Standard	State after TR	Open after TR	Final	Published	Publication
G1	Biometric Data Interchange Format - Part 1: Data Format	ISO/IEC 19794-1	Final	Final	Final	2005	2005	ISO/IEC 19794-1	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 2: Data Format	ISO/IEC 19794-2	Final	Final	Final	2005	2005	ISO/IEC 19794-2	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 3: Data Format	ISO/IEC 19794-3	Final	Final	Final	2005	2005	ISO/IEC 19794-3	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 4: Data Format	ISO/IEC 19794-4	Final	Final	Final	2005	2005	ISO/IEC 19794-4	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 5: Data Format	ISO/IEC 19794-5	Final	Final	Final	2005	2005	ISO/IEC 19794-5	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 6: Data Format	ISO/IEC 19794-6	Final	Final	Final	2005	2005	ISO/IEC 19794-6	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 7: Data Format	ISO/IEC 19794-7	Final	Final	Final	2005	2005	ISO/IEC 19794-7	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 8: Data Format	ISO/IEC 19794-8	Final	Final	Final	2005	2005	ISO/IEC 19794-8	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 9: Data Format	ISO/IEC 19794-9	Final	Final	Final	2005	2005	ISO/IEC 19794-9	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 10: Data Format	ISO/IEC 19794-10	Final	Final	Final	2005	2005	ISO/IEC 19794-10	Final	Final	Final	2005	2005
G2	Biometric Data Interchange Format - Part 11: Data Format	ISO/IEC 19794-11	Final	Final	Final	2005	2005	ISO/IEC 19794-11	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 12: Data Format	ISO/IEC 19794-12	Final	Final	Final	2005	2005	ISO/IEC 19794-12	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 13: Data Format	ISO/IEC 19794-13	Final	Final	Final	2005	2005	ISO/IEC 19794-13	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 14: Data Format	ISO/IEC 19794-14	Final	Final	Final	2005	2005	ISO/IEC 19794-14	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 15: Data Format	ISO/IEC 19794-15	Final	Final	Final	2005	2005	ISO/IEC 19794-15	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 16: Data Format	ISO/IEC 19794-16	Final	Final	Final	2005	2005	ISO/IEC 19794-16	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 17: Data Format	ISO/IEC 19794-17	Final	Final	Final	2005	2005	ISO/IEC 19794-17	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 18: Data Format	ISO/IEC 19794-18	Final	Final	Final	2005	2005	ISO/IEC 19794-18	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 19: Data Format	ISO/IEC 19794-19	Final	Final	Final	2005	2005	ISO/IEC 19794-19	Final	Final	Final	2005	2005
	Biometric Data Interchange Format - Part 20: Data Format	ISO/IEC 19794-20	Final	Final	Final	2005	2005	ISO/IEC 19794-20	Final	Final	Final	2005	2005



National Established Technical Committee M1, Biometrics, in June 2001. Currently has 31 member. As of September 2010, ANSI/INCITS has published 28 biometric standards covering technical interfaces, data formats, application profiles, and performance testing. M1 serves as the U.S. Technical Advisory Group for ISO/IEC JTC 1 SC 37. End users: Commercial and civilian applications – e.g. PIV



International Established Sub Committee 37 Biometrics in Nov. 2002 (and has been very busy). Currently has 28 national body + 10 observer. 6 working groups (Vocabulary + Interfaces + Data Formats + Profiles + Testing + Societal). ISO has published 38 in the above mentioned areas. End users: Commercial and civilian applications – e.g. Indian UID, ICAO e-passport



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Focus and Impact

NIST Biometric Quality Program Push Towards Zero Error Biometrics

Strengthening Science	Advancing metrology	Developing Standards	Developing Tool Box	Best Practice Guidance	Enumerative Bibliography	Coordination+ Collaborations
<p>Failure Analysis</p> <p>Identifying the likely causes of recognition error, quantifying their effect and ways to mitigate them.</p>	<p>Performance Evaluation</p> <p>Quantitative means of assessing performance of quality assessment algorithms (IREX II IQCE)</p>	<p>Requirements Specifications</p> <p>On image properties affecting performance, and on capture device</p>	<p>Open source Public domain</p> <p>Reference implementations of quality assessment algorithm, iris segmentation</p>	<p>Instructional + Guidance</p> <p>Materials for quality score summarization + Best capture practice + example images of various quality</p>	<p>Technical Literature</p> <p>Reports, white papers, publications relevant to biometric quality and iris image quality in particular</p>	<p>Workshops, Conferences</p> <p>Grants (WVU, NYU Poly)</p>
Research	Evaluation	Standard	Software	Report	Webpage	
<p>NIST IR 7155</p> <p>ICIP 2005</p> <p>NIST IR 7820</p>	<p>NIST IR 7820</p> <p>PAMI 2007</p> <p>ICPR 2010</p>	<p>ISO/IEC 29794</p> <p>ISO/IEC 19794</p>	<p>NFIQ 1.0</p> <p>NFIQ 2.0</p> <p>NIIQ 1.0</p>	<p>NIST IR 7422</p> <p>NIST IR 8XXX</p>	<p>www.nist.gov/itl/iad/ig/bio_quality.cfm</p>	<p>BQW 2006, 07</p> <p>IBPC 2010, 12</p> <p>NFIQ 2010,12</p>