

STANDARDS FOR CERTIFYING BIOMETRIC ACCURACY

November 2002

R. Michael McCabe

mccabe@nist.gov

<http://www.itl.nist.gov/iad/vip/new.html>

DEFINITIONS

- ❑ Biometrics - Automated methods of recognizing a person based on a physical or behavioral characteristics

- ❑ Identification – One-to-many matching
Is this person in the database?

- ❑ Verification – One-to-one matching
Is this person who (s)he claims to be?

PATRIOT ACT ENHANCED BORDER SECURITY & VISA REFORM ACT

- ❑ **PL 107-56:** The Attorney General and the Secretary of State jointly, through the National Institute of Standards and Technology (*NIST*), *....shall within 1 year after the date of the enactment of this section, develop and certify a technology standard (including appropriate biometric identifier standards)* that can be used to verify the identity of persons applying for a US visa or such persons seeking to enter the US pursuant to a visa for the purposes of conducting background checks, confirming identity, and ensuring that a person has not received a visa under a different name.....

- ❑ **PL 107-173:** later than 180 days after the enactment of this Act, the Attorney General, the Secretary of State, and The National Institute of Standards and Technology (NIST), acting jointly, shall submit to the appropriate committees of Congress a comprehensive report assessing the actions that will be necessary... deployment of equipment and software necessary to allow biometric comparison and authentication of documents...Not later than October 26, 2004.

STATUTORY MANDATES

- ❑ Develop and certify a *biometric* technology standard
 - Verify identity of foreign nationals applying for a visa
 - *Visa application at embassies and consulates*
 - *Background check against FBI criminal database and INS databases and “watch lists”*
 - *Ensure person has not received visa under a different name (consolidation)*
 - Verify identity of persons seeking to enter the U.S.
 - *Verify that the person holding the travel document is the same person to whom the document was issued*
 - *Airports, land border crossings, sea entry points*

NIST STATUTORY MANDATES

- ❑ NIST must work together with Dept of Justice (including FBI & INS) and Dept of State to develop a report on these activities and submit it to Congress under section 303a of the Border Security Act.
- ❑ NIST must determine estimates of the accuracy for different biometrics in the 303a report.
- ❑ NIST must establish document authentication standards for tamper-resistant travel documents in the 303a report.
- ❑ NIST must provide interoperability standards.

TEST DATA SETS

- Biometric accuracy determination requires use of large-scale databases for testing
 - sample size of 100 -1K Proves feasibility
 - sample size of 1K - 10K Measures subject variation
 - sample size of 10K - 1M Measures operational QC
- Large realistic test samples of images have been obtained from the State and Justice Departments & Texas.
- Initial testing will be of face and fingerprints.
- No large sample of iris data is presently available. This is potentially a valuable technology that has not been fully tested.

IMAGE TESTS

- All tests conducted by NIST use image-based biometrics.
- No face or fingerprint templates were used for any of the tests conducted.
- Most vendors state that their products only work when their own proprietary templates are used.

PERFORMANCE MEASUREMENT TOOLS

- ❑ Identification: Algorithm Test Bed (ATB)
 - Scaled down version of FBI's IAFIS at NIST (9/02)
 - Test combinations of rolled and plain finger images
 - Test use of less than ten finger images

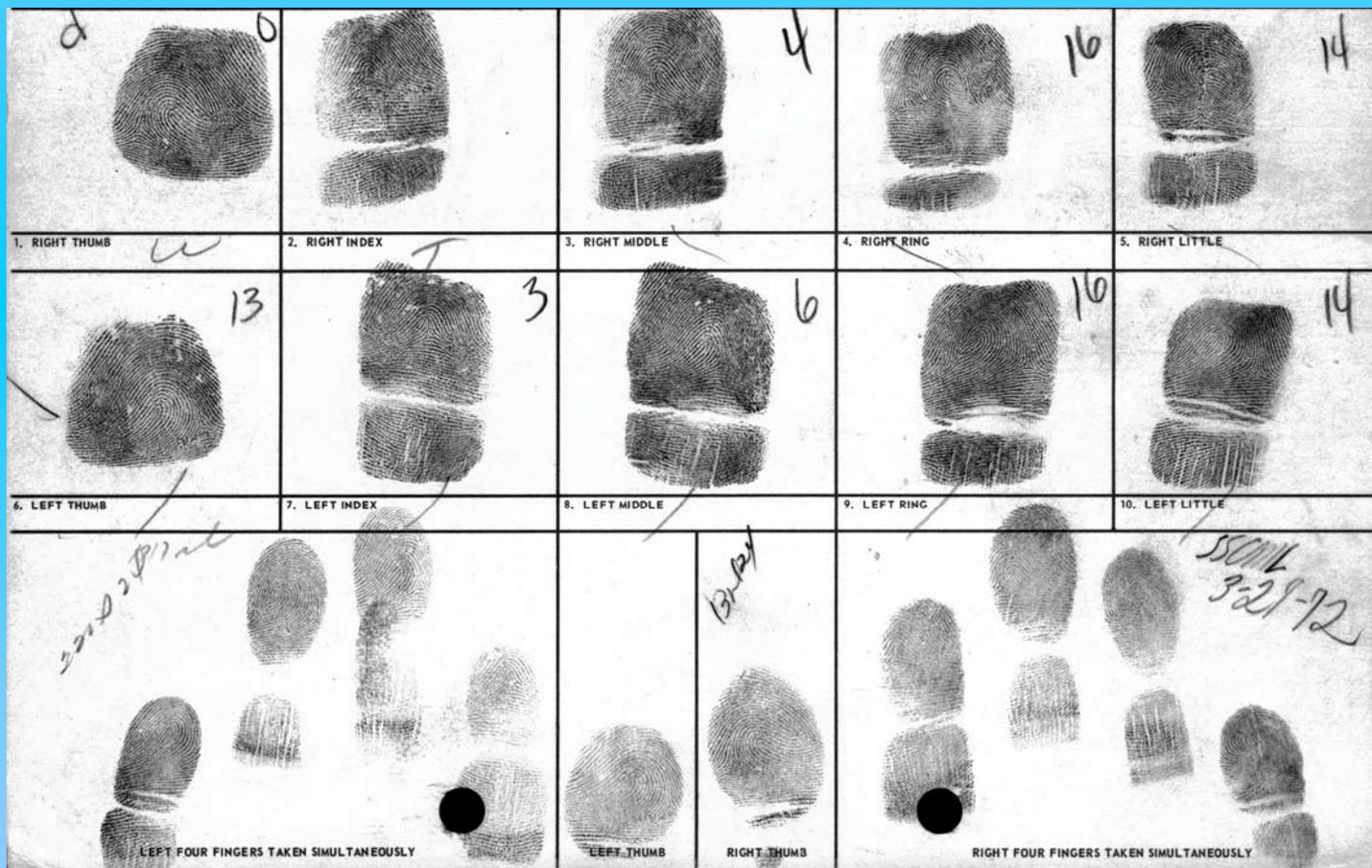
- ❑ Verification: Verification Test Bed (VTB)
 - Developed by the Image Processing Group
 - Gigabit network of 16 nodes
 - Test the use of single finger images

- ❑ FRVT 2002 - Facial Recognition Vendors Test

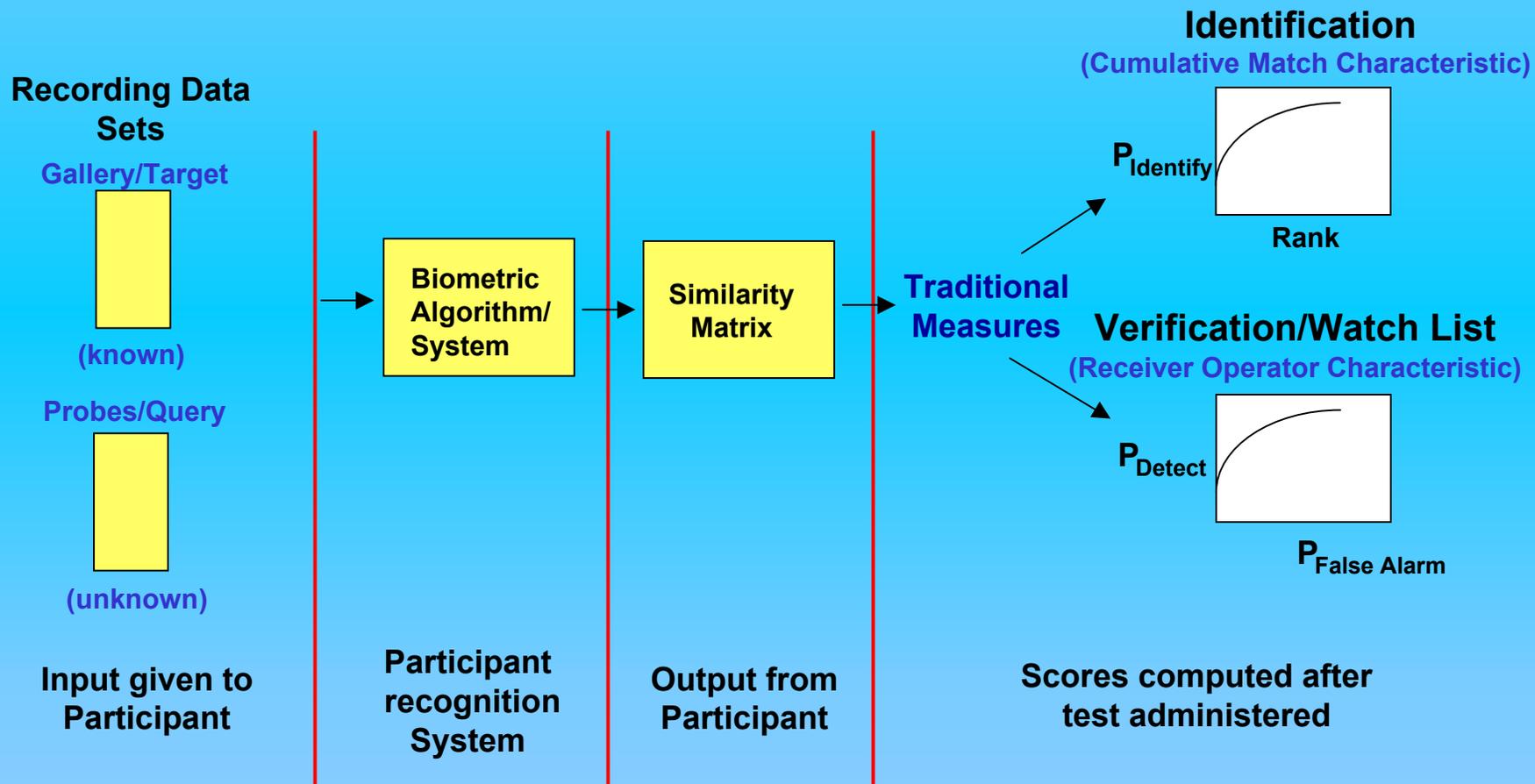
FINGERPRINT DATA SETS

NAME	SCAN TYPE	PLAIN	ROLL	TESTS	SIZE	QUALITY
SD 14 (V2)	Ink/live		10	Roll:Roll	2,700 Card Pairs	Medium
SD 24	Live (DFR-90)	10		Plain:Plain	80	Good
SD 29	Ink	10	10	Roll:Roll Plain:Plain Plain:Roll	216 Card Pairs	Medium
INS	Live	Index		Plain:Plain	1M Pairs	Operational
INS	Live	10	10	Plain:Roll	100K Cards	Operational
TX	Ink/live	10	10	Plain:Roll	1M Cards	Operational
ESD	Live	10	10	Plain:Roll	3K Cards	Good

TENPRINT CARD (Rolled and Plain)



BIOMETRIC PERFORMANCE MEASUREMENT FRAMEWORK



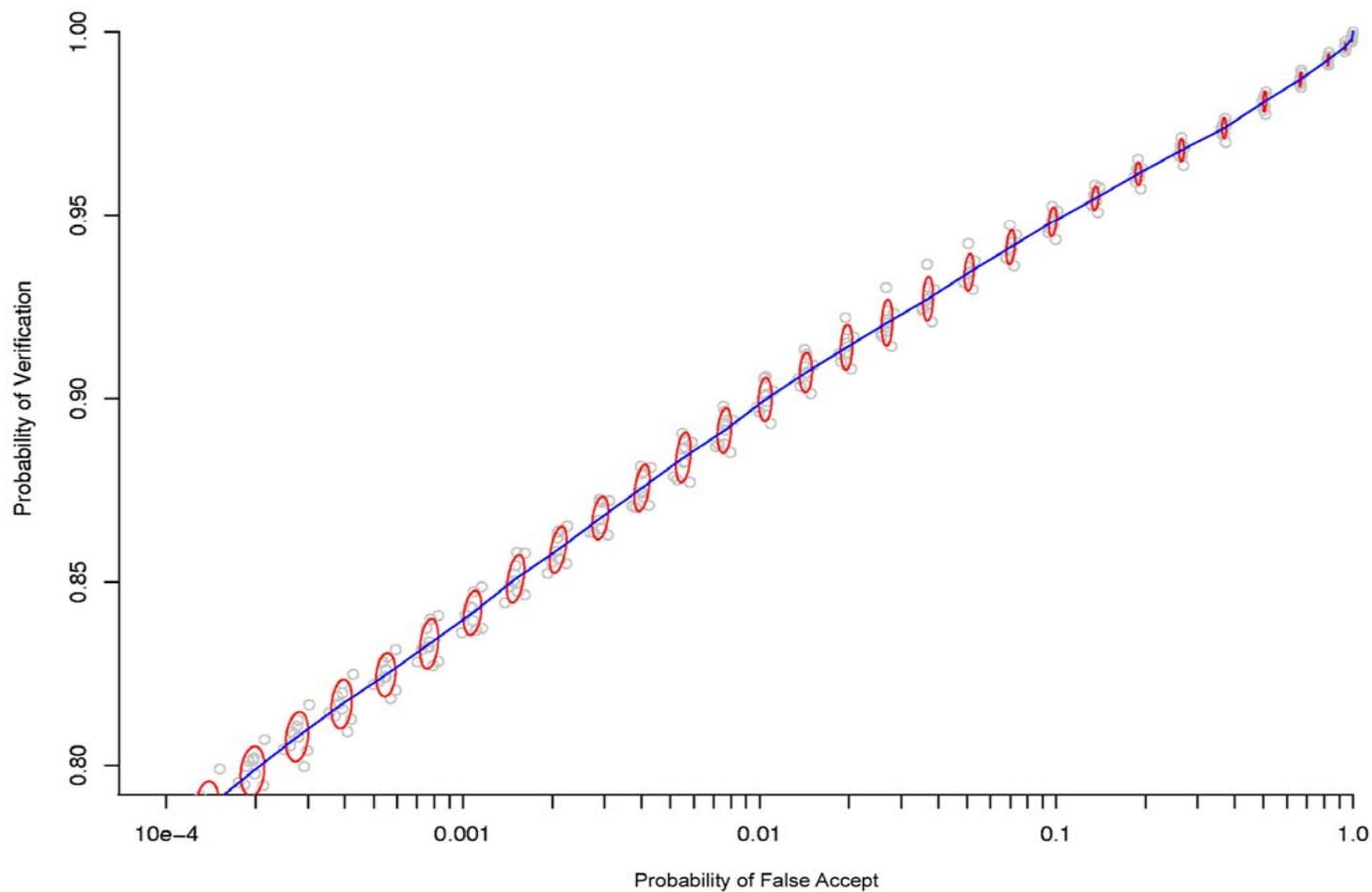
SIMILARITY MATRIX

	<i>FP-1</i>	<i>FP-2</i>	<i>FP-3</i>	<i>FP-4</i>
<i>FP-1</i>	95	87	54	68
<i>FP-2</i>	90	97	78	46
<i>FP-3</i>	51	72	91	35
<i>FP-4</i>	67	43	29	89

FINGERPRINT VERIFICATION

- ❑ This is a one to one match situation.
- ❑ Sample sizes need to be large enough to capture subject variation.
- ❑ Used 60,000 operational quality fingerprint from the INS.
- ❑ Achieved 90% probability of verification at 1% false accepts.
- ❑ Achieved 77% probability of verification at 0.01% false accepts

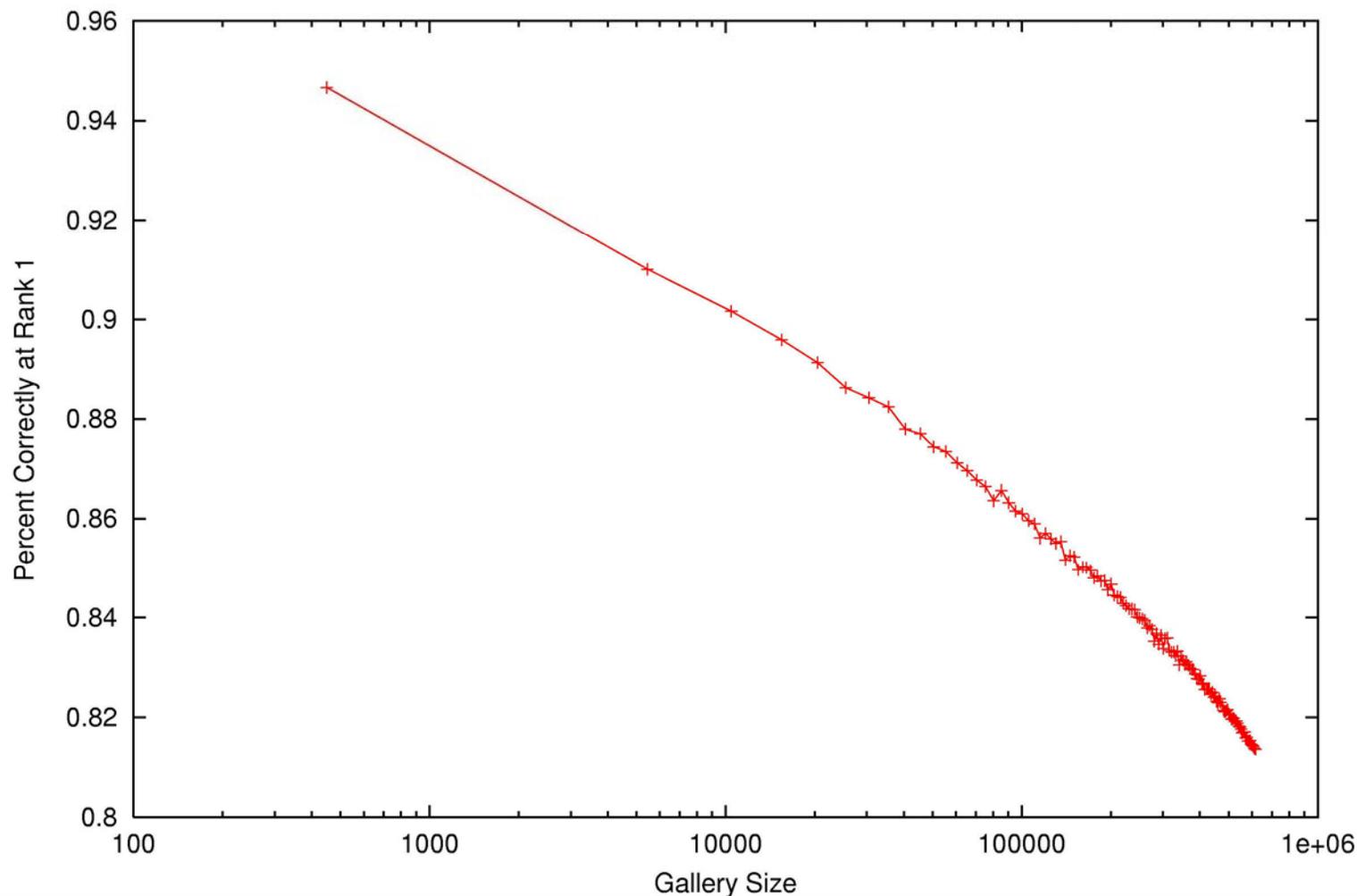
ROC PLOT FOR FINGERPRINT VERIFICATION



FINGERPRINT IDENTIFICATION

- ❑ This is a one to many match situation.
- ❑ Sample sizes need to be large enough to capture large scale image quality variations.
- ❑ Used 620,000 operational quality fingerprint from the INS
- ❑ Achieved 96% probability of identification at rank one on a gallery size of 500.
- ❑ Achieved 90% probability of identification at rank one on a gallery size of 10,000.
- ❑ Achieved 86% probability of identification at rank one on a gallery size of 100,000.

FINGERPRINT PROBABILITY OF DETECTION vs GALLERY SIZE



DEVELOPING STANDARDS

- ❑ Biometric Standards Committee M1 Formed 1/02
- ❑ ISO/IEC JTC1 SC37 Formed
- ❑ Data Interchange standards (ANSI/NIST 1-2000)

Fingerprint Standard

- *Minutiae*
- *Pattern*
- *Image*

Facial Standard

- *Image*

Iris

- *Image (Polar/Rectangular)*

STATUS OF NIST PATRIOT ACT BIOMETRIC STANDARDS

- ❑ Previous work on fingerprint identity searches by Mitretek has shown that an acceptable identification can be obtained using four fingers in the FBI IAFIS. Further tests with improved algorithms are being run at NIST.
- ❑ Using realistic INS data, one index fingerprint can provide 90% probability of verification with a 1% probability of false acceptance for identity verification.
- ❑ Results from FRVT 2002 have yet to be considered.
- ❑ Interoperability standards for data exchange being developed.

STATUS OF NIST PATRIOT ACT BIOMETRIC STANDARDS (cont)

- ❑ Not all subjects can be easily fingerprinted. About 2%-3.5% have damaged friction ridges.
- ❑ The intelligence community often only has face data.
- ❑ This indicates that a dual biometric system including one or more fingerprint images and a face image on a chip may be needed to meet existing system requirements.