Developments in Latent Fingerprint Technologies

Evaluation of Latent Fingerprint Technologies (ELFT) Project

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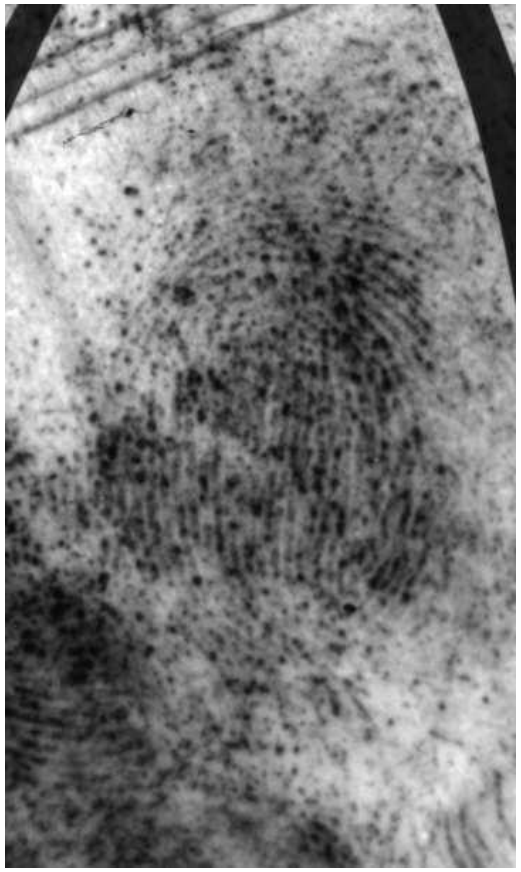
Rolled Fingerprint

(ink capture)

Plain Fingerprint

(ink capture)

Latent Fingerprint

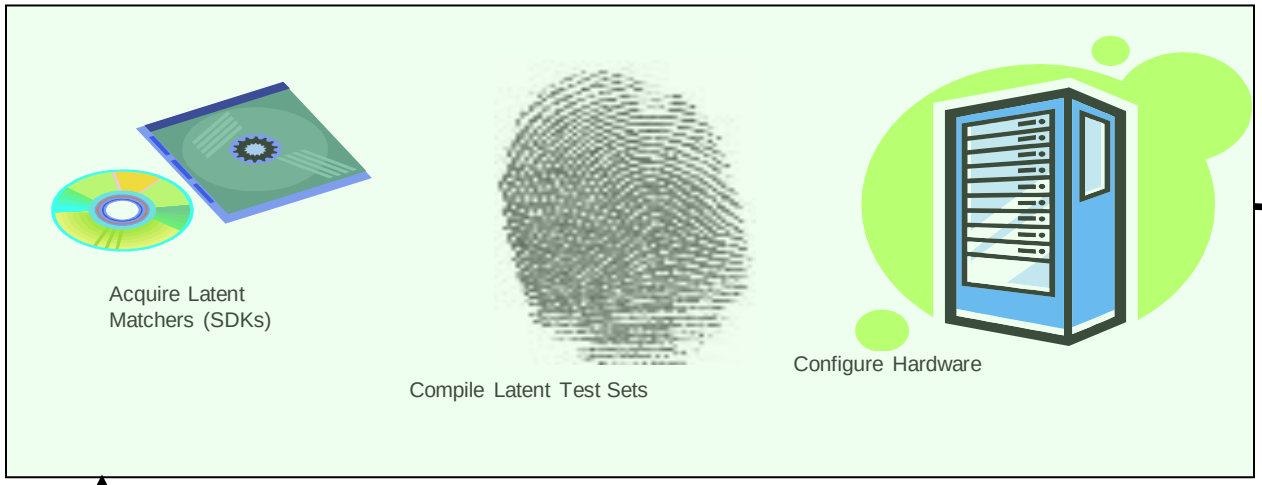


(powder lift)

ELFT Project Timeline

- 2006 — NIST Latent Fingerprint Testing Workshop
- 2007 — **ELFT Phase I Evaluation**
- 2008 — **ELFT Phase II Evaluation**
- 2009 — NIST Latent Fingerprint Testing Workshop
  ELFT Phase II Miss Analysis Sessions
  ELFT-EFS Public Challenge
- 2010 — **ELFT-EFS Evaluation #1**
  ELFT-EFS Miss Analysis Sessions
- 2011 — **ELFT-EFS Evaluation #2**

NIST Evaluation of Latent Fingerprint Technologies (ELFT)



Evaluation Protocol

- **Execute 1-to-Many searches**
  - **Image-only searches**
  - **Examiner-assisted searches (image + feature markup)**
  - **Operational images**
  - **Extended Feature Sets**
- **Measure & Analyze Results**
  - **Accuracy**
  - **Selectivity**
  - **Resource requirements**
  - **Gap analysis**

Iterate process

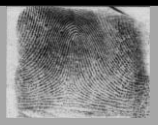
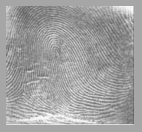
1. **Evaluation Reports**
2. **Feedback to Standardization**
3. **Technological Gap Analysis**
4. **Reference Data**

Latent Examiner

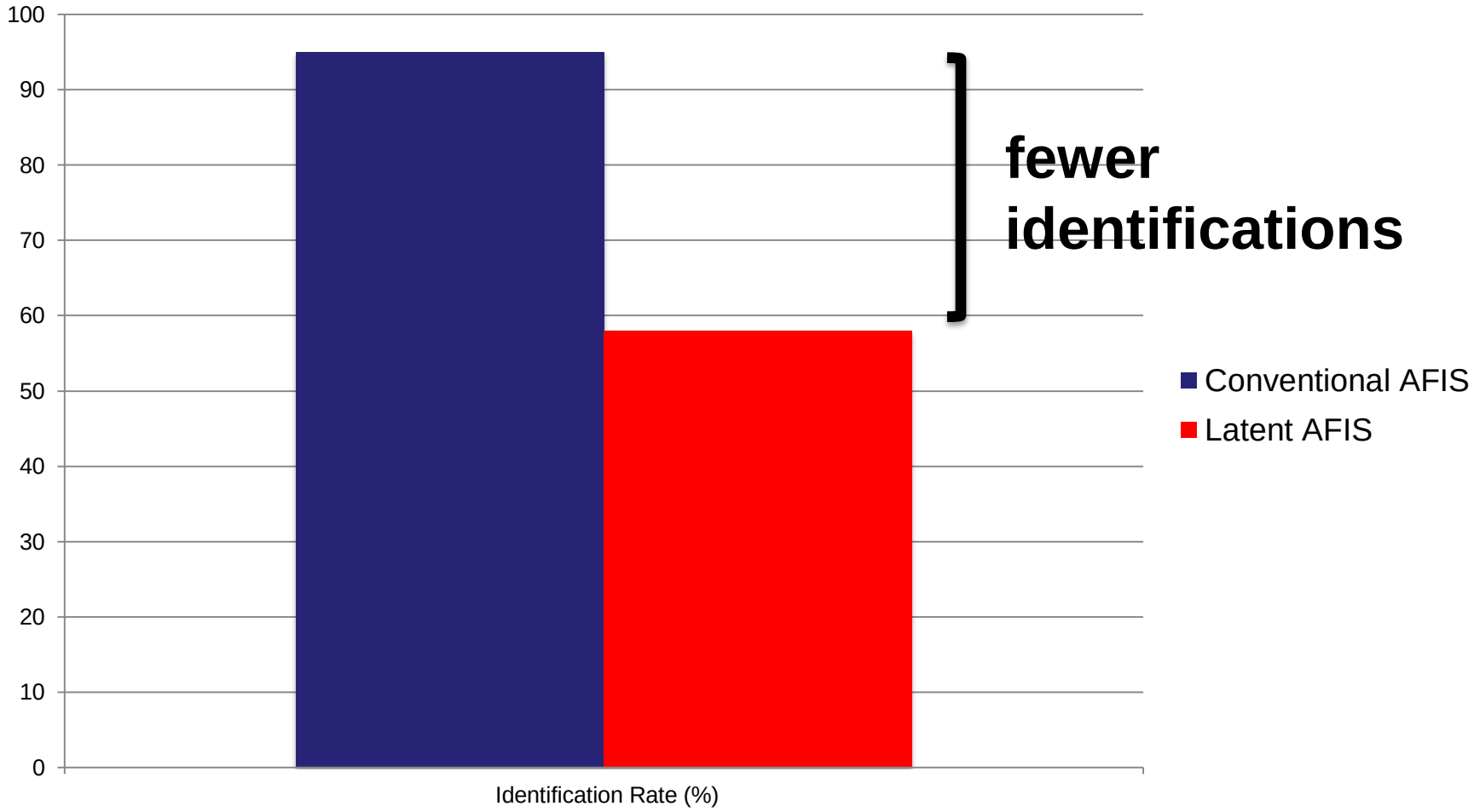
Latent image (+ features) "Search"

AFIS

Potential matches

Rank	Candidate
1	
2	
3	
…	
20	

Latent AFIS Technology Gaps: Relatively Low Accuracy

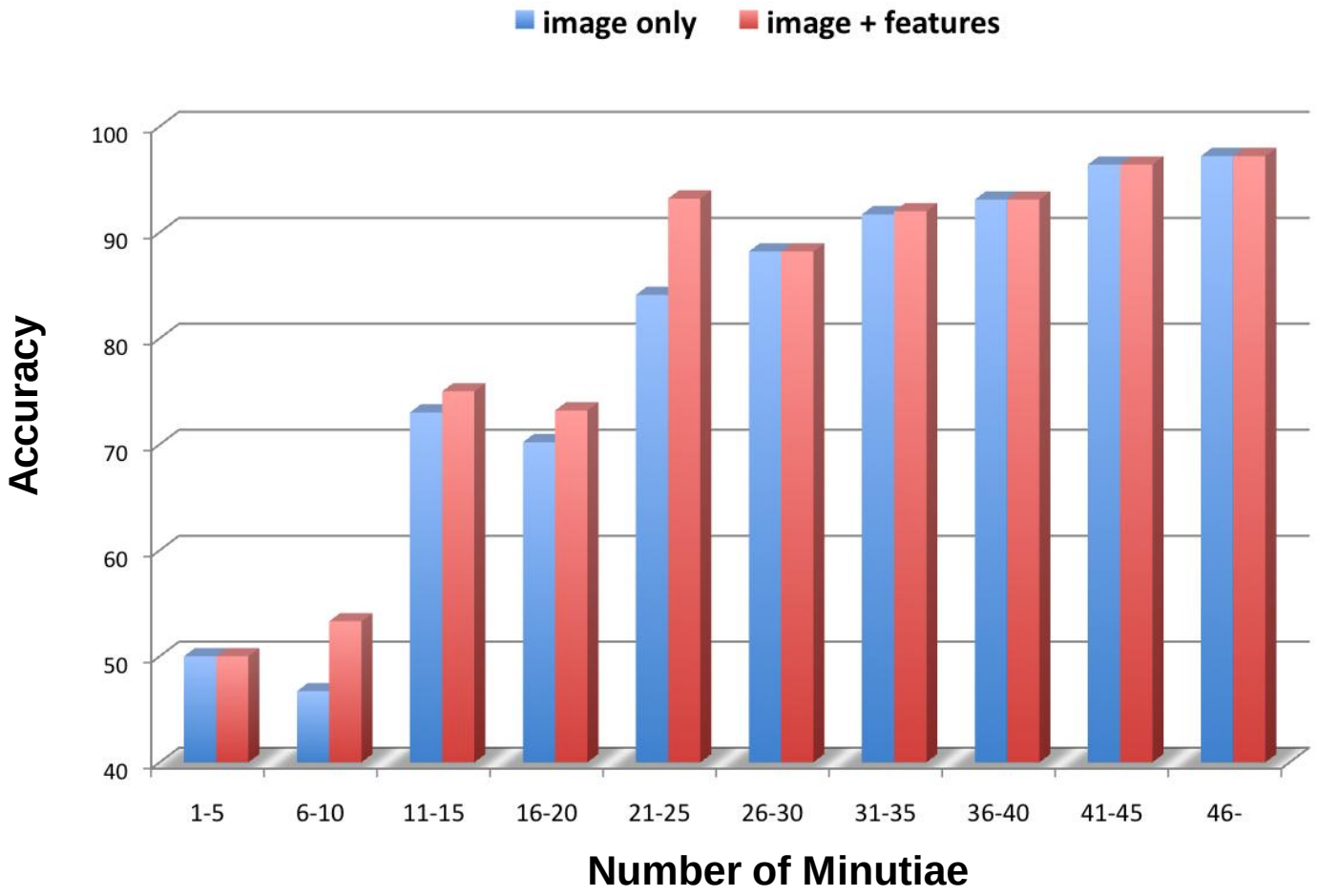


Latent AFIS Technology Gaps

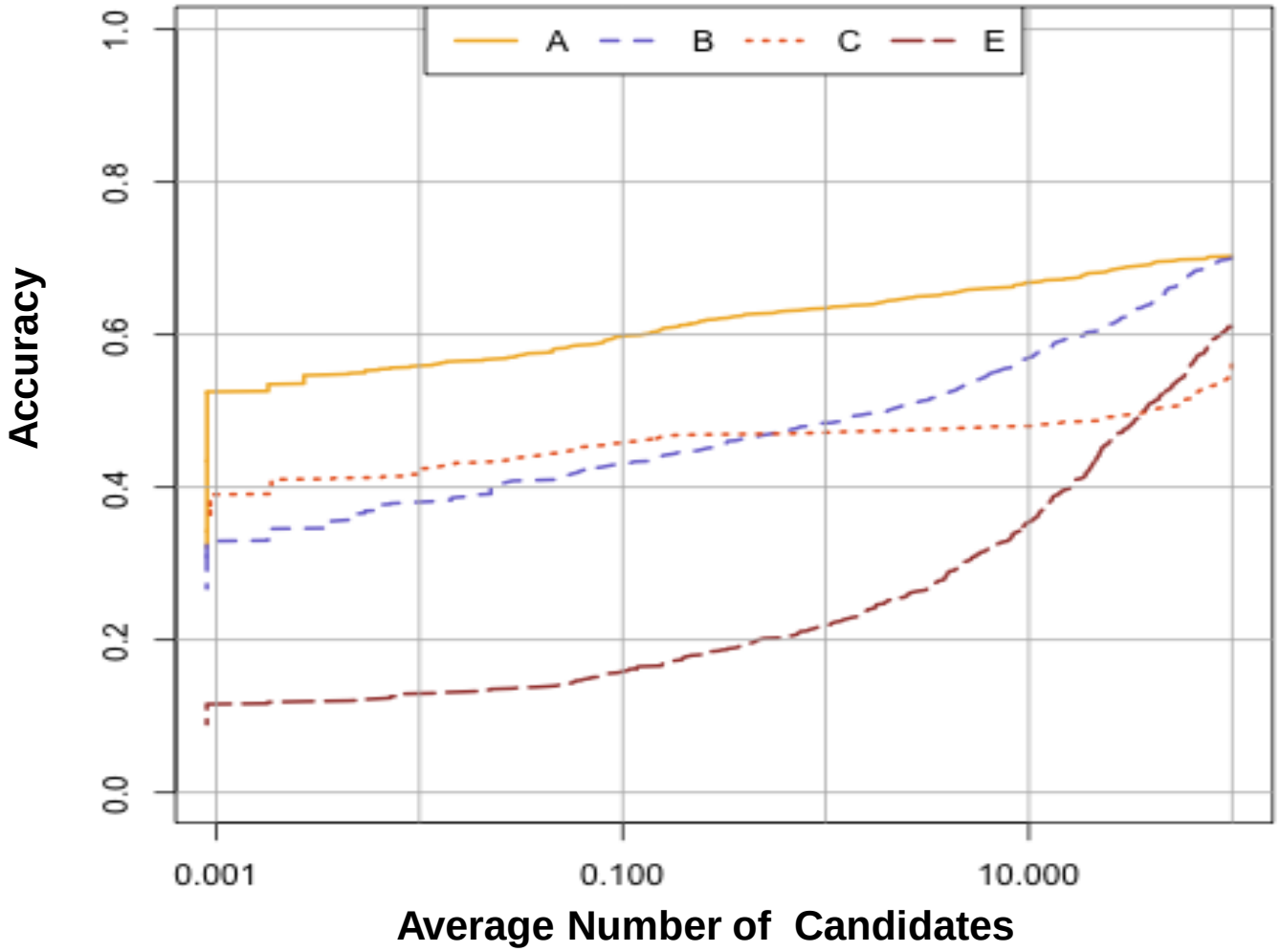
- **Relatively low accuracy**
  - 65-70% identification rate considered “high performance”
- **High manual workload**
  - features selection & markup
  - candidate list evaluation

Solution: Measurement and evaluation of searches using image only (“lights out”) vs. manually assisted search performance, and evaluation of candidate list reduction methods.

ELFT Results:
"Lights out" vs Manual Feature Selection



ELFT Results: Accuracy vs. Examiner Workload

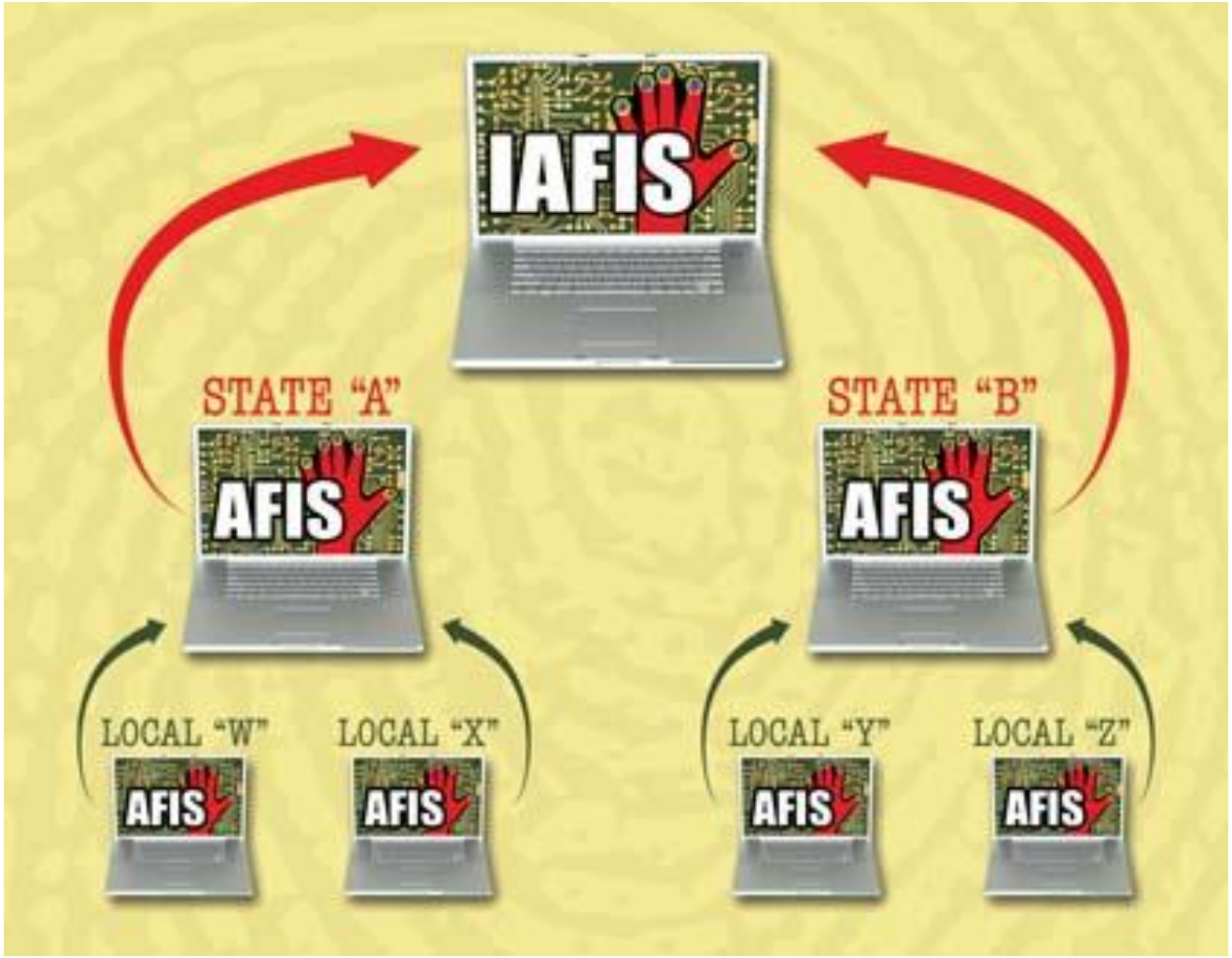


Latent AFIS Technology Gaps

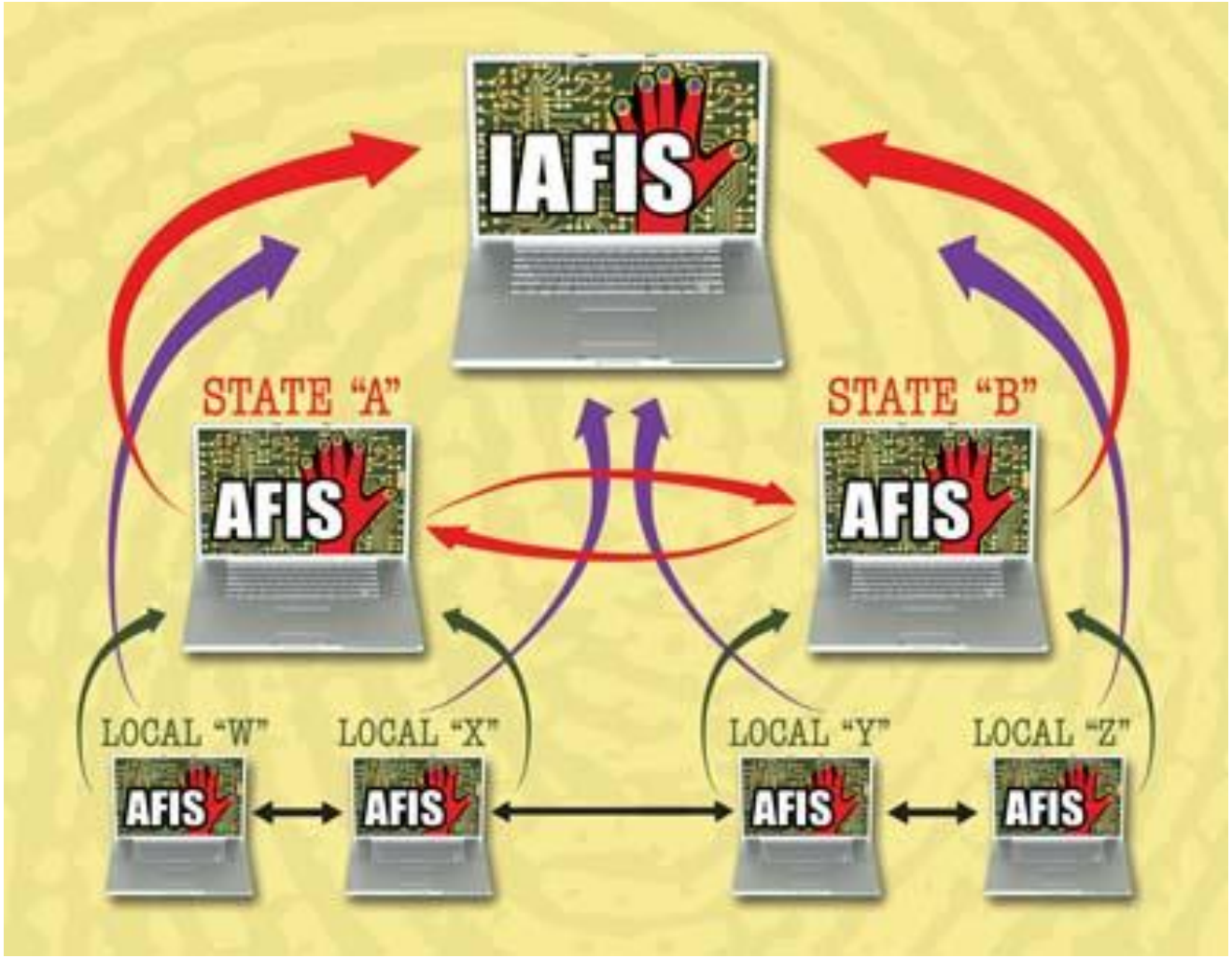
- **Limited interoperability**
  - best accuracy requires manual feature selection/markup
  - commercial AFIS use non-standard features
  - even the same features vary between AFIS
  - no universal standard for feature selection/markup
  - features re-selected/marked for each new AFIS searched

Solution: Develop a comprehensive set of features which can be used to build a universal set of latent fingerprint search transactions. Latent Interoperability Transmission Specification (LITS) based on ANSI/NIST-ITL 2011 which includes Extended Feature Sets (EFS) and FBI EBTS.

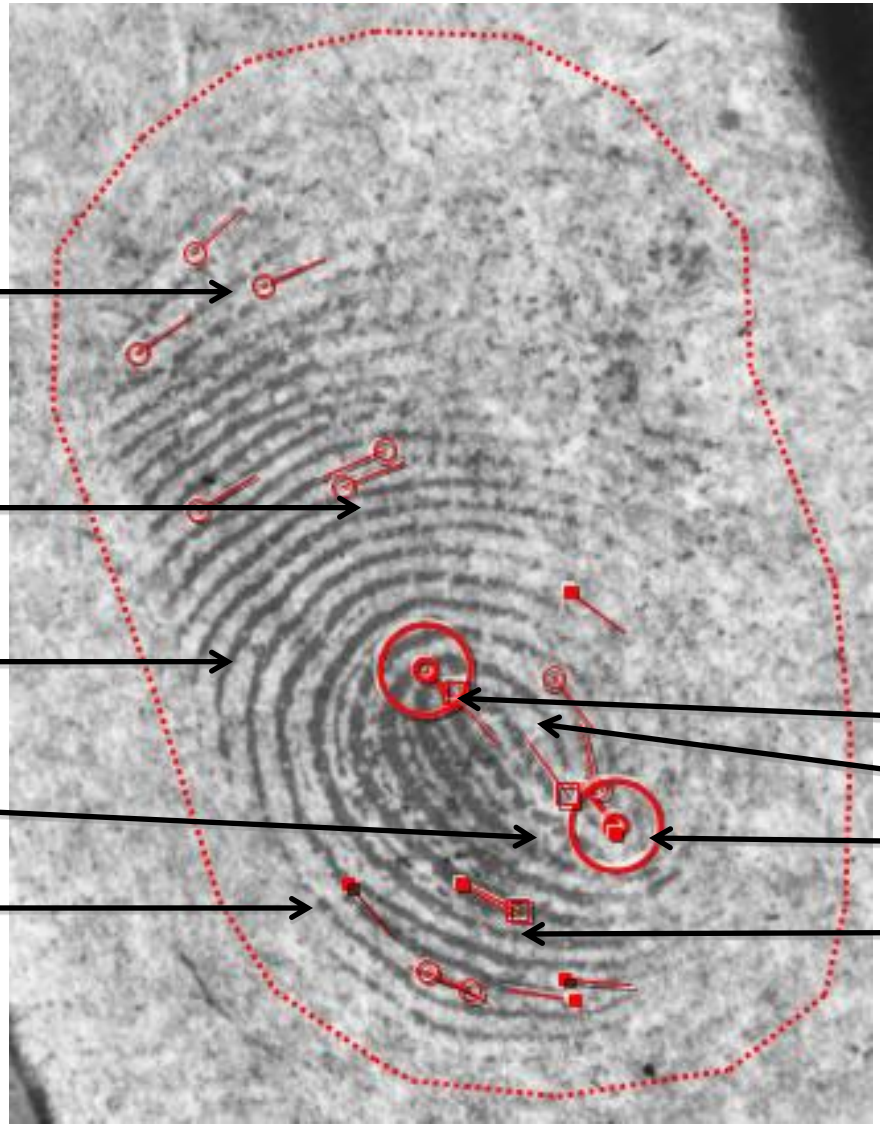
AFIS Interoperability: Now



AFIS Interoperability: Future



Extended Feature Set (EFS)



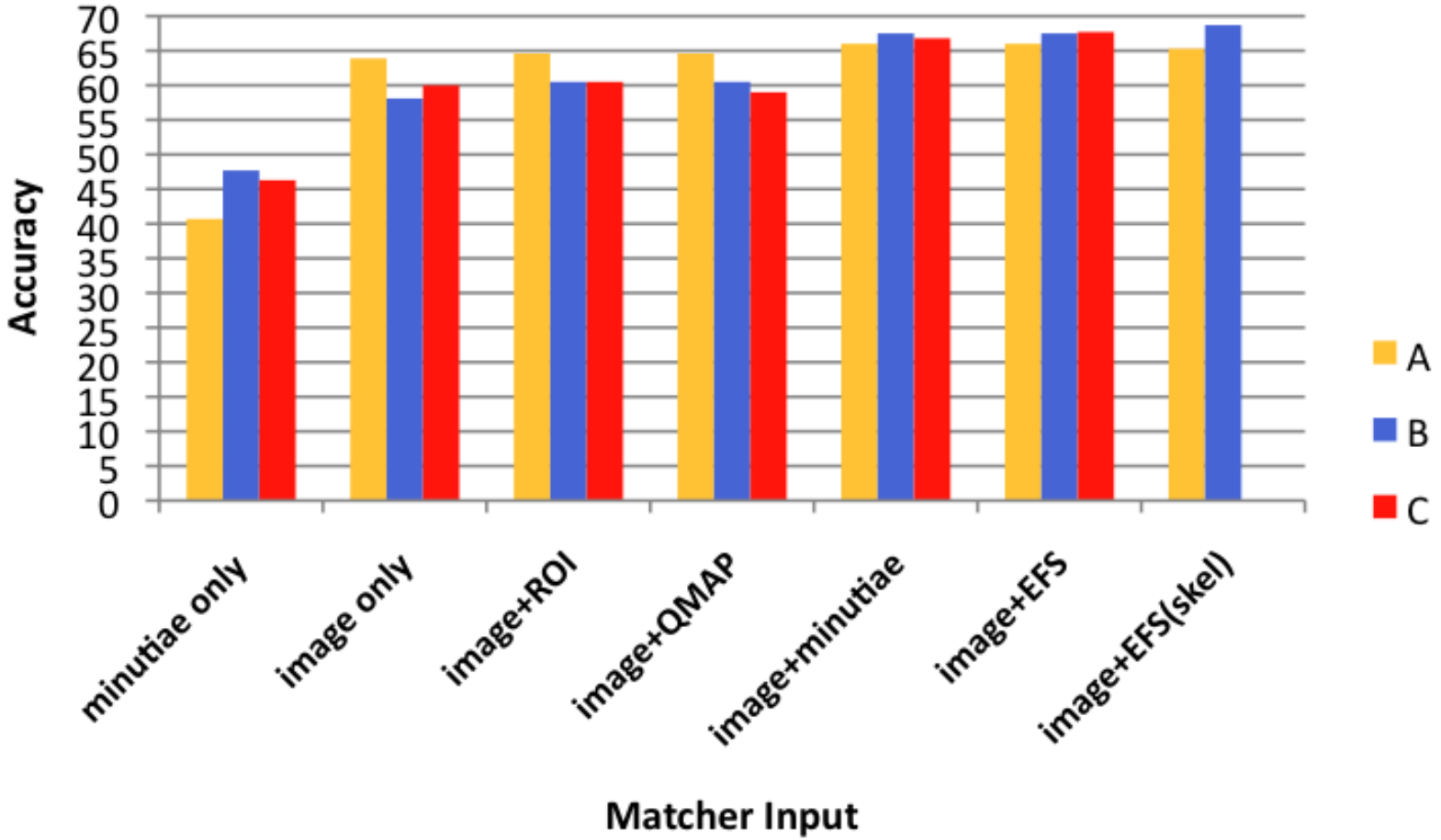
- **Improved Feature Quality**
  - NEW ○ *region quality map*
- **Improved Feature Set:**
  - ○ *endings/bifurcations*
  - ○ *pores*
  - ○ *protrusions*
  - NEW ○ *incipient ridges*
  - ○ *dots*
  - ○ *creases*
  - ○ *scars*
  - ○ *skeleton*

EFS Evaluation & Testing

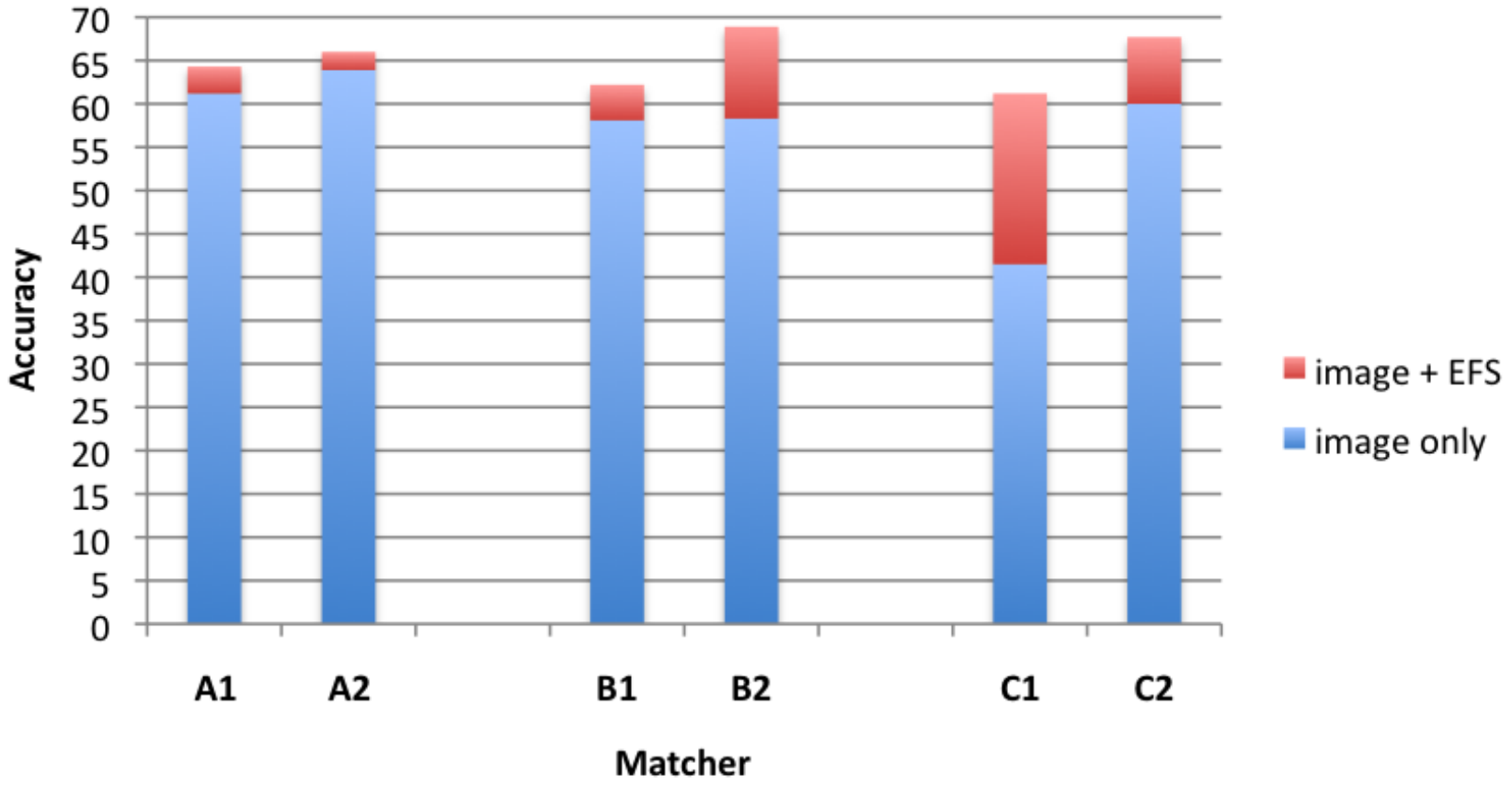
- **ELFT-EFS Evaluation #1**
  - 1st Multi-vendor AFIS matcher evaluation using a common feature set (EFS)
  - Features defined by upcoming ANSI/NIST-ITL 2011 standard
  - Feature marked by experienced latent examiners using a common guidelines
  - Assesses the performance of latent AFIS search technology with:
    - ✓ minutiae only
    - ✓ image only
    - ✓ image + *various subsets of* EFS
  - Final Report: **NISTIR 7775**, March 2011

- **ELFT-EFS Evaluation #2**
  - Re-iteration of Evaluation #1 with updated algorithms
  - Follows miss analysis sessions conducted with developers
  - Measures improvements/regressions in matcher performance
  - Provides better estimate of state of the art
  - Final Report TBD October 2011

ELFT-EFS Results: Accuracy vs. EFS Feature Subset



ELFT-EFS Results: Accuracy Improvement (Eval 1 vs. 2)



Future Work

- ELFT-LITS *(start date to be announced Fall 2011)*
  - LITS = Latent Interoperability Transmission Specification (LITS)
  - evaluation of LITS based search transaction performance
- ELFT-PALM *(start date to be announced Fall 2011)*
  - evaluation of AFIS performance for latent palm vs. enrolled palm
- Future ELFT evaluations will also evaluate:
  - high-, medium-, and low-resource algorithm performance tradeoffs
  - “reverse latent” (rolled-/plain-print to enrolled latent) matching performance
  - fusion approaches to enhancing performance

For More Information…

Web ➔ http://fingerprint.nist.gov/latent

Email ➔ latent-efs@nist.gov

Presentation Overview

1. Introduction to automated latent print ID
2. Automated latent ID technology (AFIS)
3. Latent AFIS technology gaps
4. NIST latent testing & evaluation (ELFT)

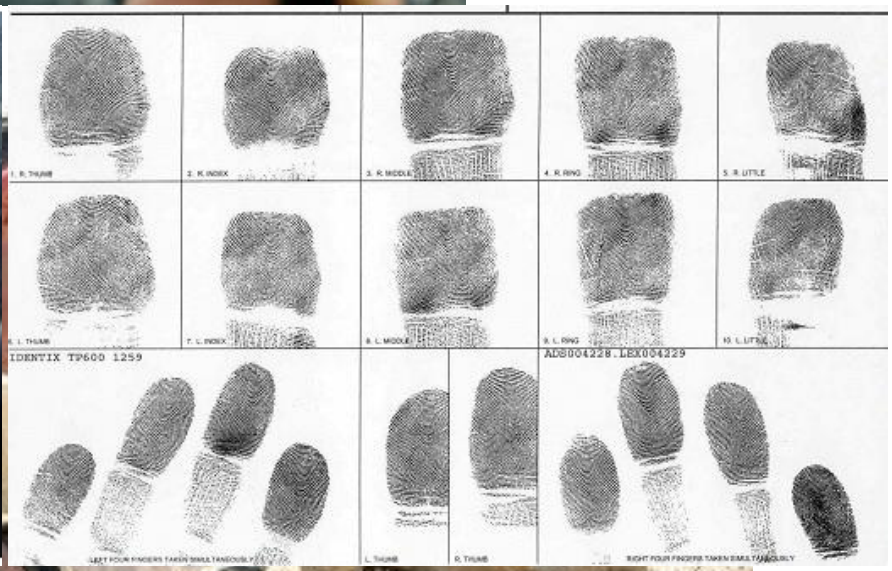
Automated Latent Fingerprint Identification Systems (AFIS)

Latent workstation

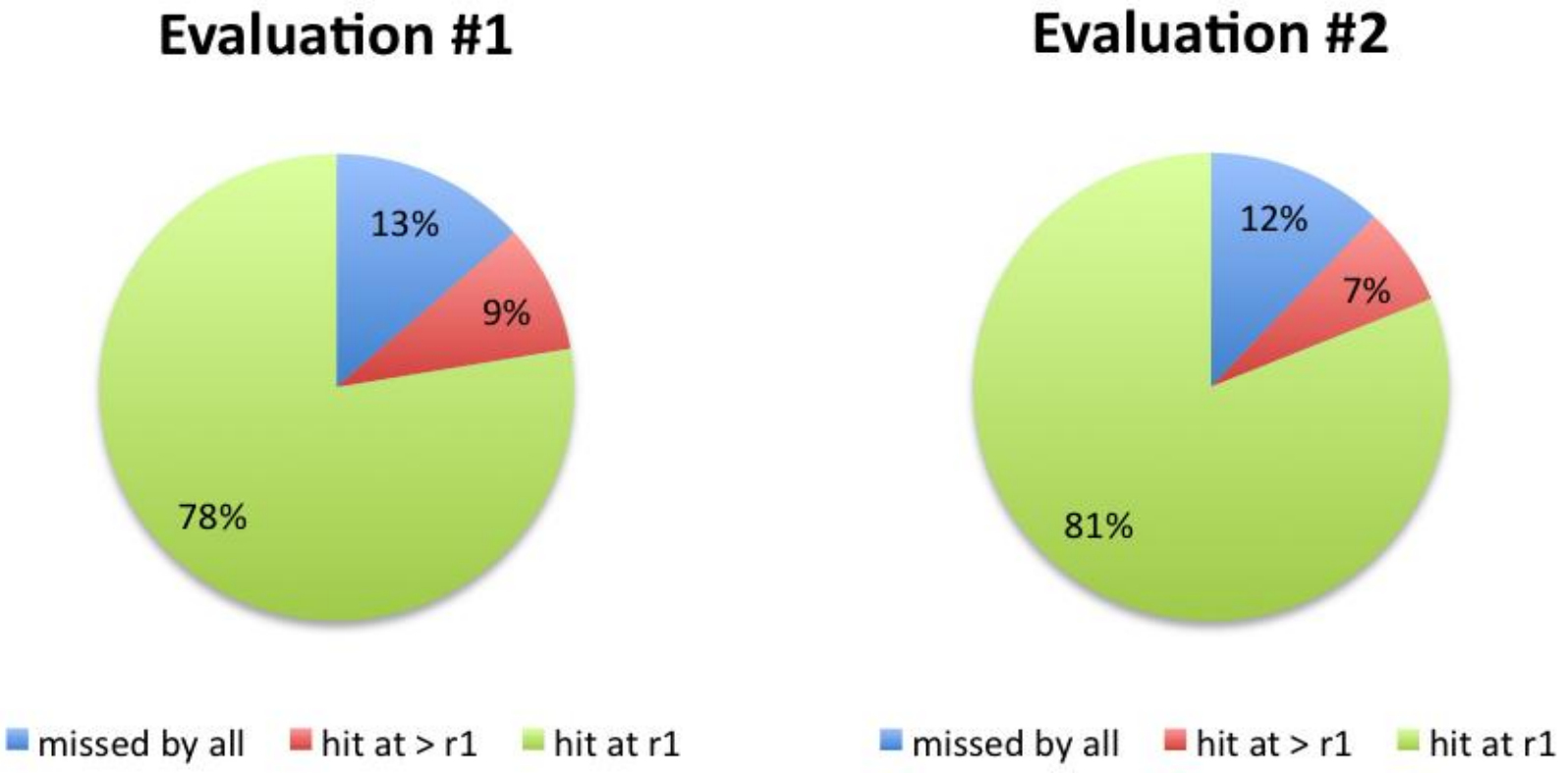
Latent matching unit & database (AKA "AFIS")

Homeland Security

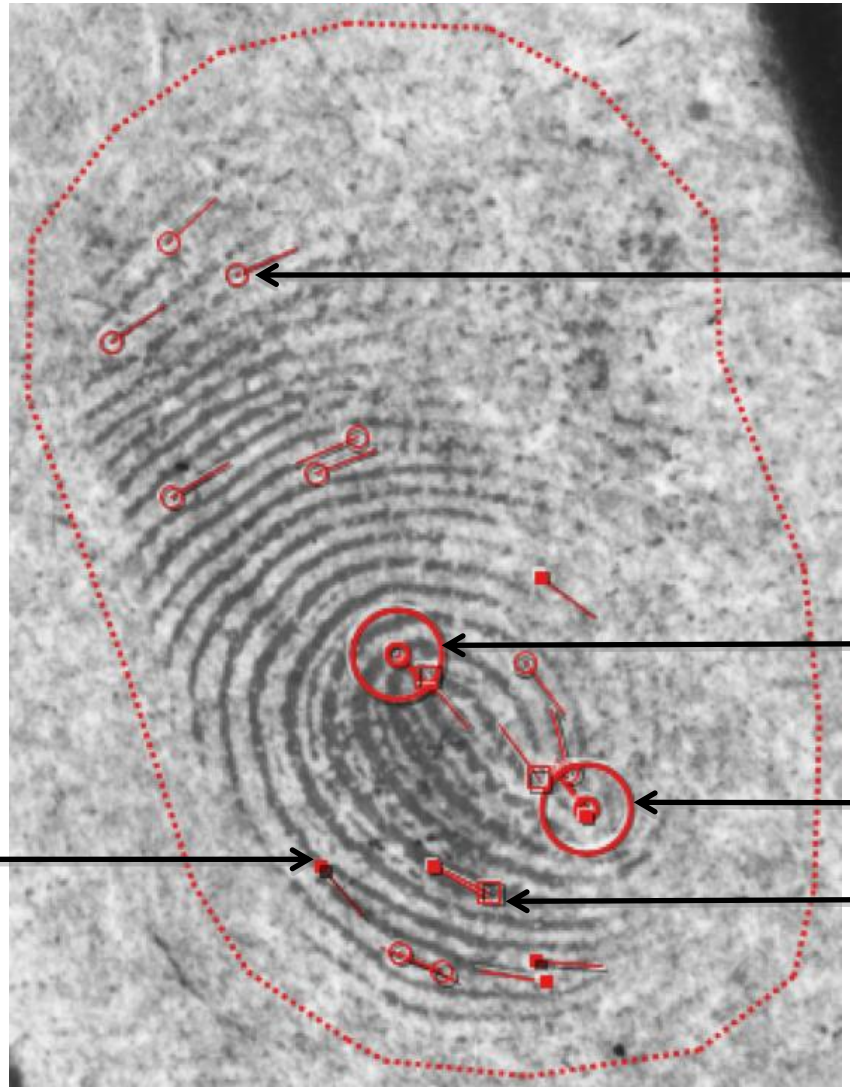
Law Enforcement / Criminal Justice



Collective Matcher Performance (1,114 latents)



Latent Examiner



Latent Workstation Screenshot

Roadblocks to Interoperability

- **Lack of cross-jurisdictional interconnectivity**
  - technological differences
  - lack of exchange processes/agreements
  - funding issues, usage policies, legal issues, …
- **Variation in feature selection, markup, and exchange**
  - best accuracy requires hand-marked features
  - lack of universal standard for data exchange
  - additional AFIS searches = additional examiner workload

Solutions

- **Improve AFIS accuracy**
  - testing & evaluation to analyze performance/gaps
  - standard reference data for developers
- **Reduce the need for manual processing**
  - determine where “lights out” processing is viable
  - improved selectivity (fewer/better candidates)
- **Develop interoperable latent search features**
  - based on ANSI/NIST-ITL EFS and FBI EBTS (LITS)
  - assess accuracy and utility of interoperable features

ELFT-EFS Results: Accuracy vs. Minutiae Count