



Scenario & Technology Testing Mobile FP Verification

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Disclaimer

- Presentation is based on public information.
- Opinions and interpretations are of the presenter.
- The presenter does not represent Unique Identification Authority of India (UIDAI).



What is Unique About UID Program

- Transparency
 - Unprecedented level of technical information of the system
 - More to come
- Risks
 - Uncharted territory
- Safety Net
 - Collaboration with industry



Thank you, biometric community



Agenda

- Context
- PoC Setup & Protocol
- Results
- Conclusions



UID Context



UID: Biometrically Verifiable SSN

- Provide ID to the ID-less
- To remove ghost identities
- To improve government service delivery
- *Provide ubiquitous verifiable identity proof*
 - Banking & payment
 - Entitlements, pension
 - Mobile service
 - Access control



UID Status

- Enrollment (multi-modal biometric)
 - 36,000 enrollment stations, 87K certified operators
 - 11 models of certified devices
 - 200 Million enrolled
 - 400 Million planned for FY '13
 - 1M/day enrollment rate
 - *100 trillion person matches/day*
- Biometric Verification
 - 8 PoC
 - Two pilot programs underway



Accuracy & Performance Testing

BIOMETRIC VERIFICATION



Biometric Verifications are Coming to a Shop near You...

Aadhaar panel favours e-payment for all social safety net schemes

OUR BUREAU

SHARE · PRINT

Aadhaar brings pension home - Ramgarh village first off the line
SANTOSH K. KIRO

Aadhaar Brings Pension Home

micro ATMs

One million interoperable micro-ATM

Final report: The Finance Minister, Mr Pranab Mukherjee, and the Union Agriculture Minister, Mr Sharad Pawar, hold copies of the Final Report of the Task Force on an Aadhaar-Enabled Unified Payment Infrastructure, presented to them by the UIDAI Chairman, Mr Nandan Nilekani (extreme right), in the Capital on Thursday. — Photo: Kamal Narang

Final report submitted to Finance Minister

NEW DELHI, FEB. 23: A network of a million interoperable microATMs to be operated by business correspondents should be set up across the country to ensure that the benefits of various social sector schemes reach the intended beneficiaries.

RELATED PHOTOS



Why is Biometric Verification Challenging?

- Inclusiveness
 - Can't deny benefits.
- Diverse subjects
 - Manual labor
 - Senior and children benefit programs
- Interoperability
 - Templates from six slap scanners (enrollment)
 - 30+ single FP scanners & extractors
- Mobile network
- Variety of applications
- Zero global experience



Proof of Concepts

- 8 PoC over 9 months across India
- 50,000 subjects
- Study
 - Devices
 - # of fingers
 - FP quality
 - Demography
 - FTE or inclusiveness
 - Network, mobility

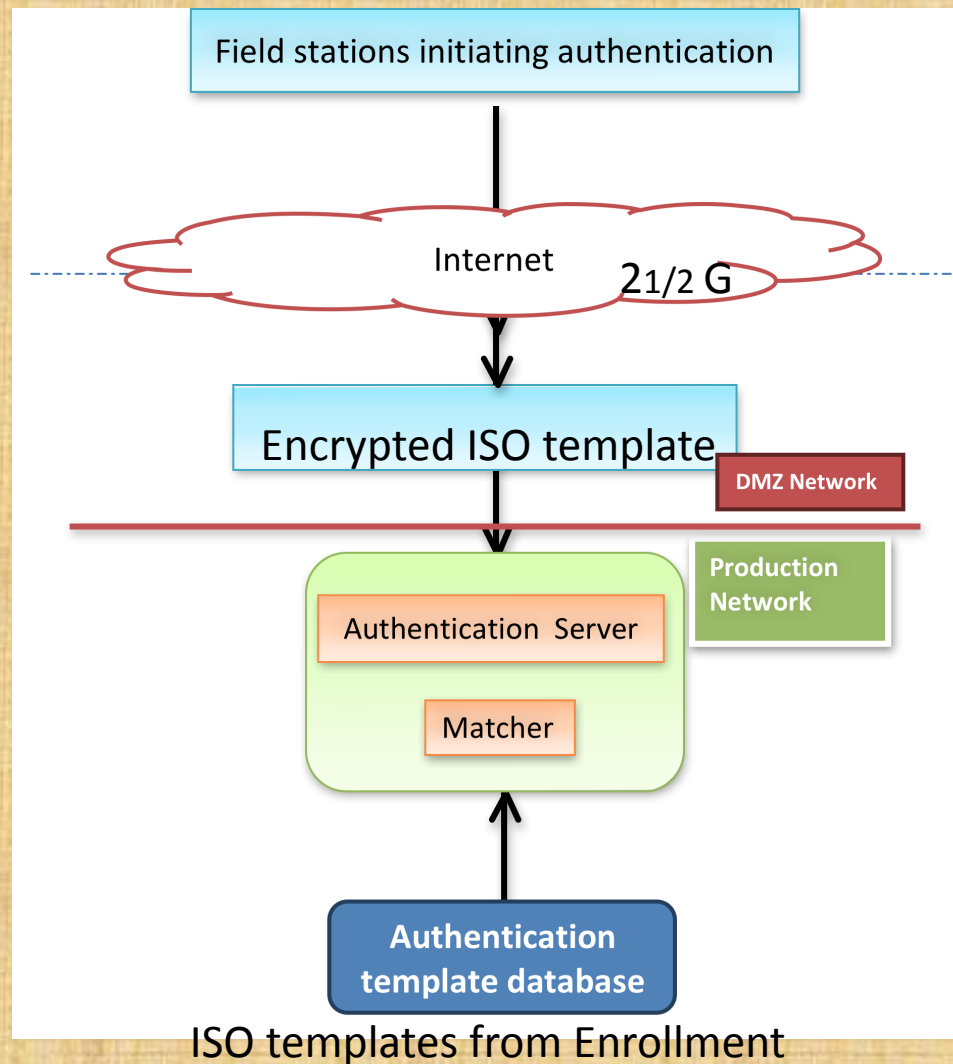


PoC #8: Combined Scenario & Technology Testing

- Scenario
 - Conducted in the real field environment
 - Real subjects representing local demography
 - Production system & network
- Technology
 - 27 single FP scanners/extractors
 - 17 distinct scanner models
 - **Every resident verifies on ALL devices**
 - Images captured at source
 - Single and two finger testing
 - Instrumented for testing
- 3,000 subjects



Authentication System



“Best Finger”

Finger that has best matching
score with corresponding enrolled
template



Best Finger Detection



ಭಾರತೀಯ ವಿಶಿಷ್ಟ ಗುರುತು ಪ್ರಾಧಿಕಾರ
ಯೋಜನಾ ಆಯೋಗ, ಭಾರತ ಸರ್ಕಾರ

सत्यमेव जयते

1. ALL FINGER CHECK

Finger check



Sequence of placing fingers



Put only finger top on device



Operator will mark your best two fingers



Right way to place fingers

Finger



Thumb



2. AADHAAR AUTHENTICATION

Place finger marked green first,



then finger marked black



Repeat this for all machines

Wrong way to place fingers

Rolling finger



Finger tip



Improper placing



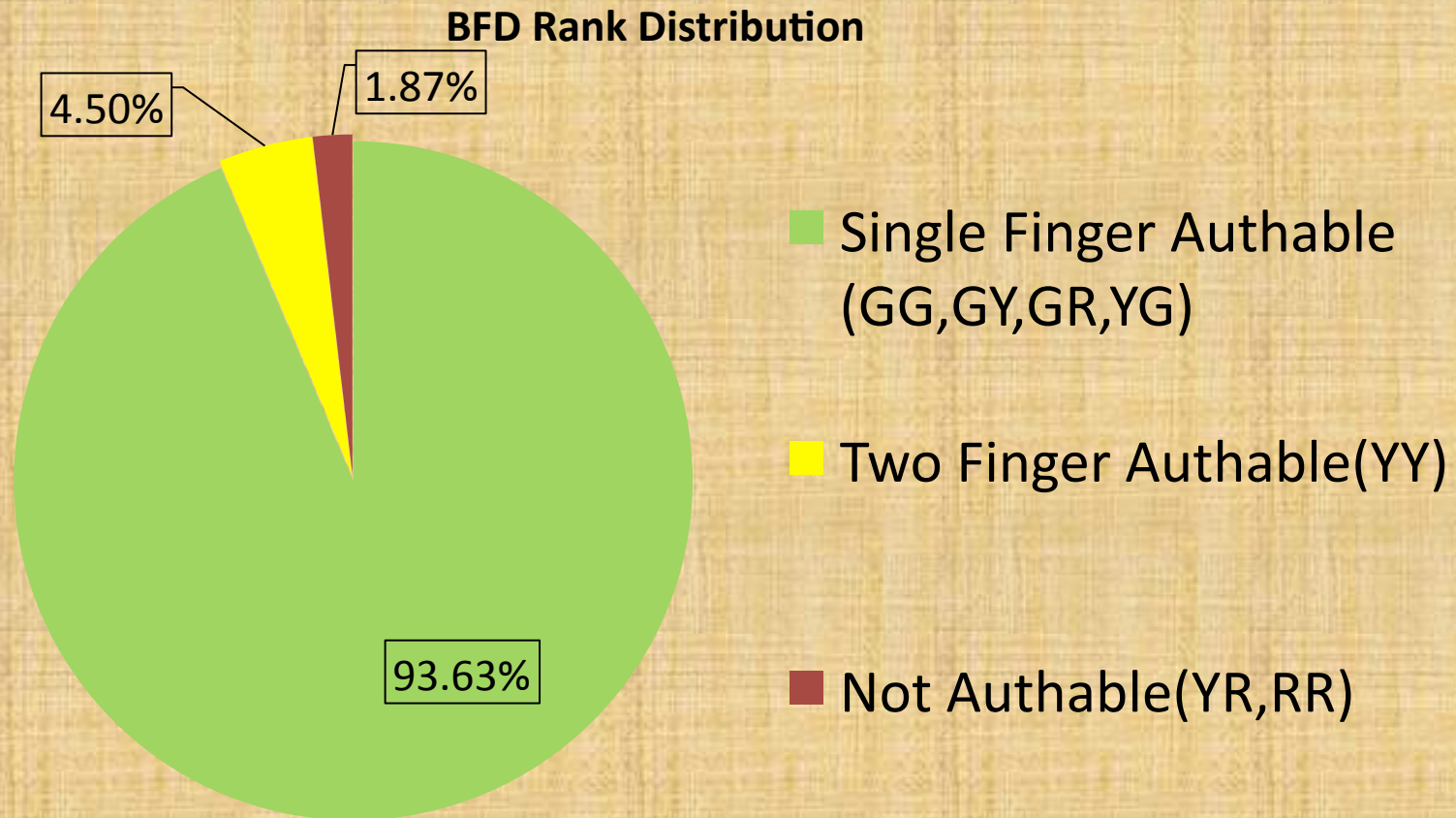
- Tie broken by preferred finger sequence
- Enrollment quality impacts BFD selection



Best Finger Results



Best Finger Results



Objective: Accuracy

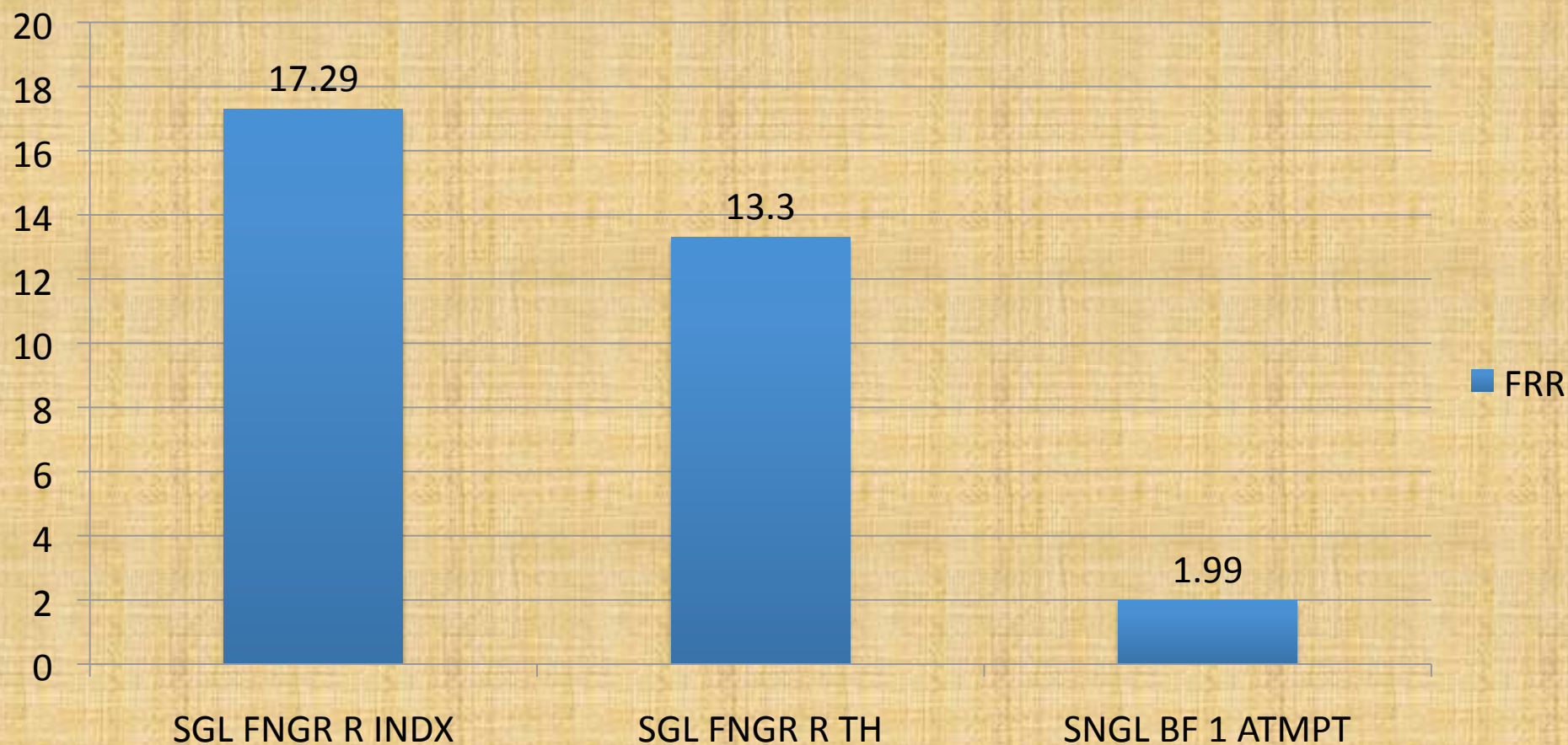
- Position, attempts and number of fingers
- Devices
- Matcher algorithm
- Demography
- Paired vs. Unpaired matching



POSITION, ATTEMPTS & NUMBER

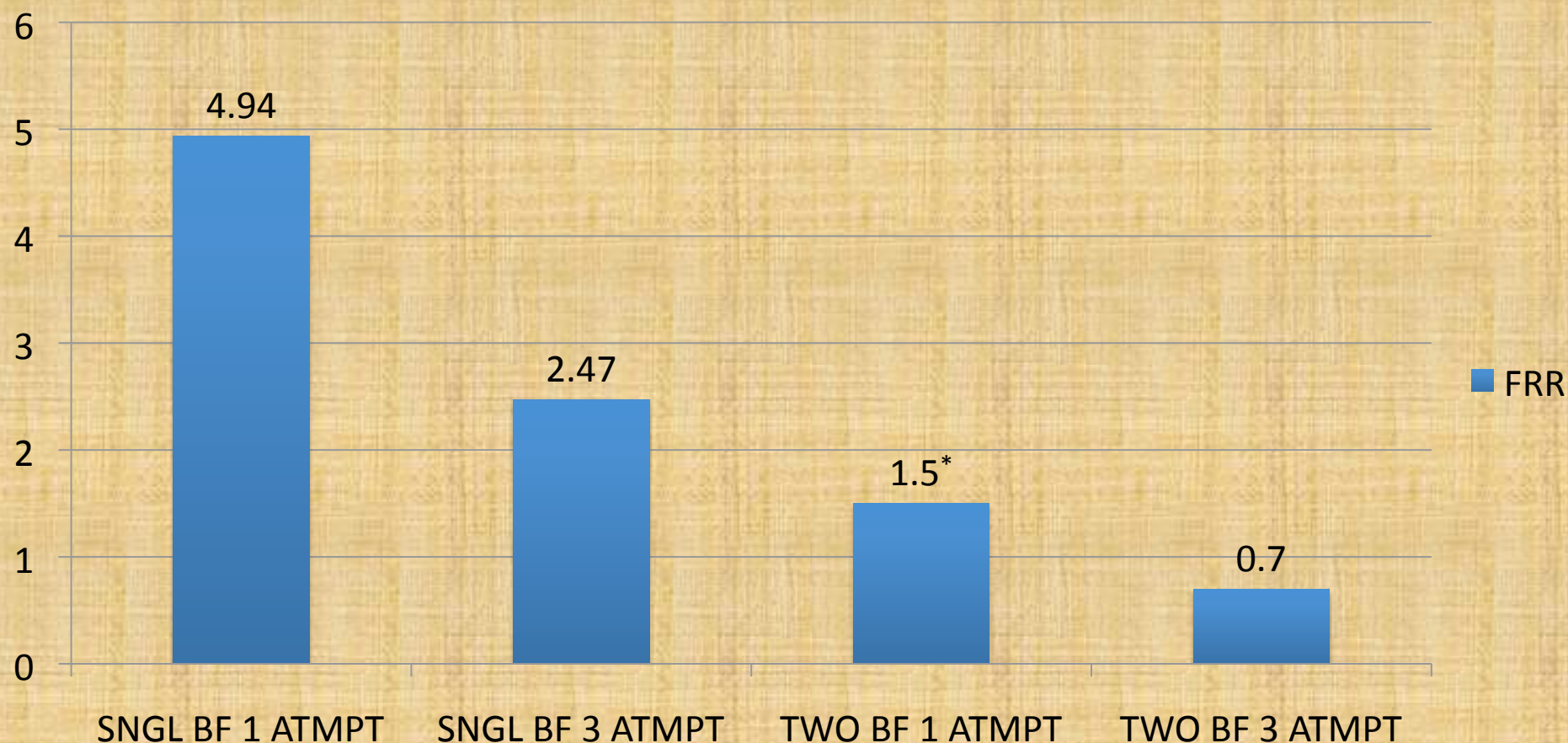


FRR @ FAR 10^{-4} On one scanner



FRR @ FAR 10^{-4}

Averaged over “good” 14 Devices/extractor



* Estimated based on corresponding unlabelled DET curve. See report



DEVICE QUALITY



Methodology

- Compare device single finger FRR to average FRR over all devices.
- Categories
 - Bad: Performed worse than average FRR
 - Good: Performed better than average FRR
 - Very Good: Performed better than average FRR of Good



Device Variation

- Among 27 devices/extractor, significant variation in quality
- *FRR results exclude “bad” devices*
- PIV compliance
- FAP (SAP)
- MINEX
- Best devices were 2 X better than average of “good”



Capture Quality

- Ergonomics
 - Placement (tip)
 - Noncore area
- FAP
 - Minimum FAP 20
- NFIQ score at image capture
 - Not usable unless full function PC is present
- Enrollment image quality adequate



MATCHER VARIATION



Matcher Performance



AGE DISTRIBUTION



Age Distribution



PAIRED VS. UNPAIRED



Unpaired Vs. Paired Algorithm



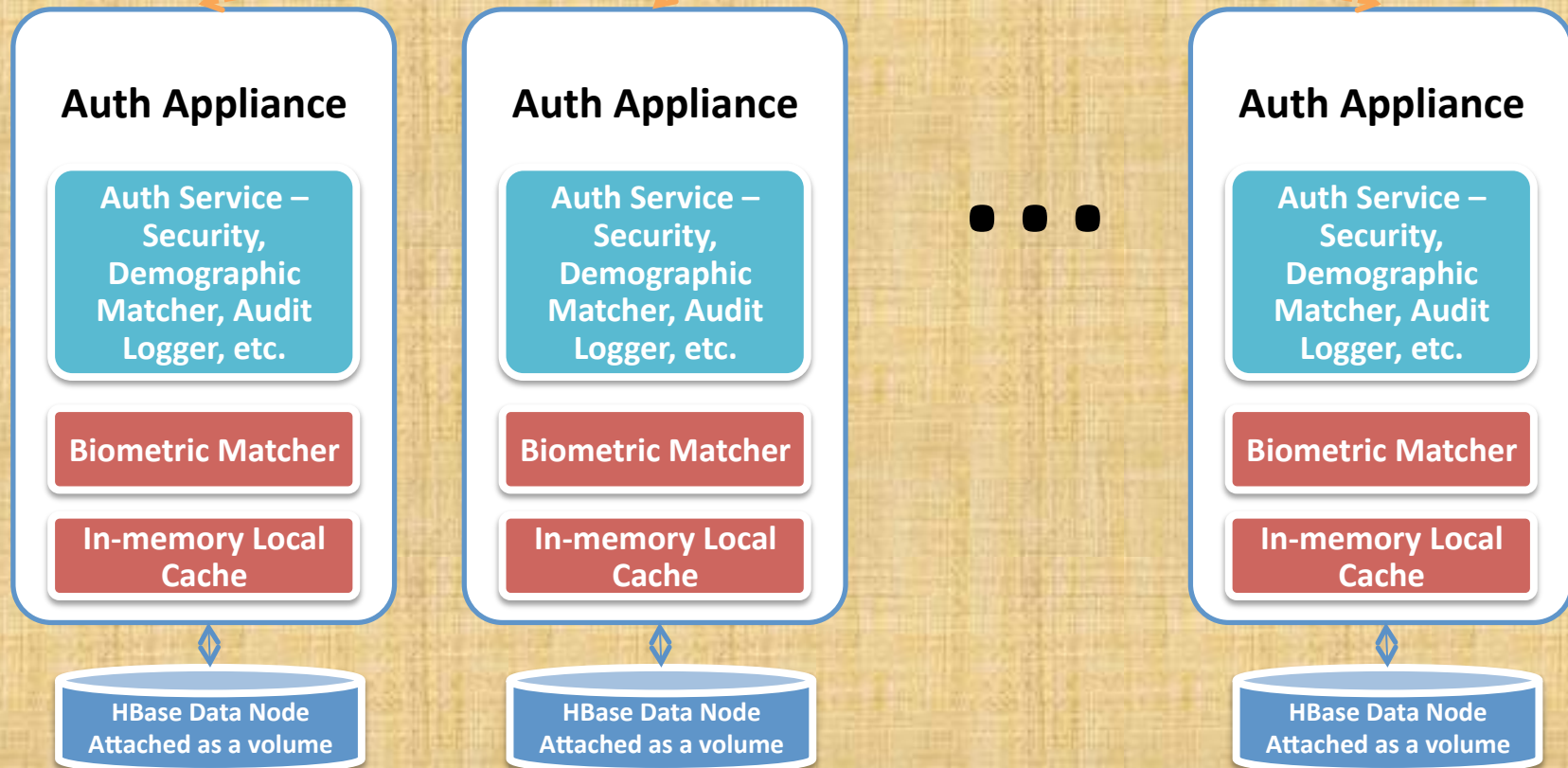
Throughput Performance

- *10 million authentications in 10 hours*
- *Average response time around 200 milliseconds or 295 concurrent requests/sec.*
- *Performance test environment consisted of*
 - *15 blade servers including database servers, biometric matching servers, messaging server, caching servers, and audit logging servers.*
 - *Configuration: x86 Linux dual CPU 6-core.*



Throughput Testing

SSL Accelerator + Load Balancer

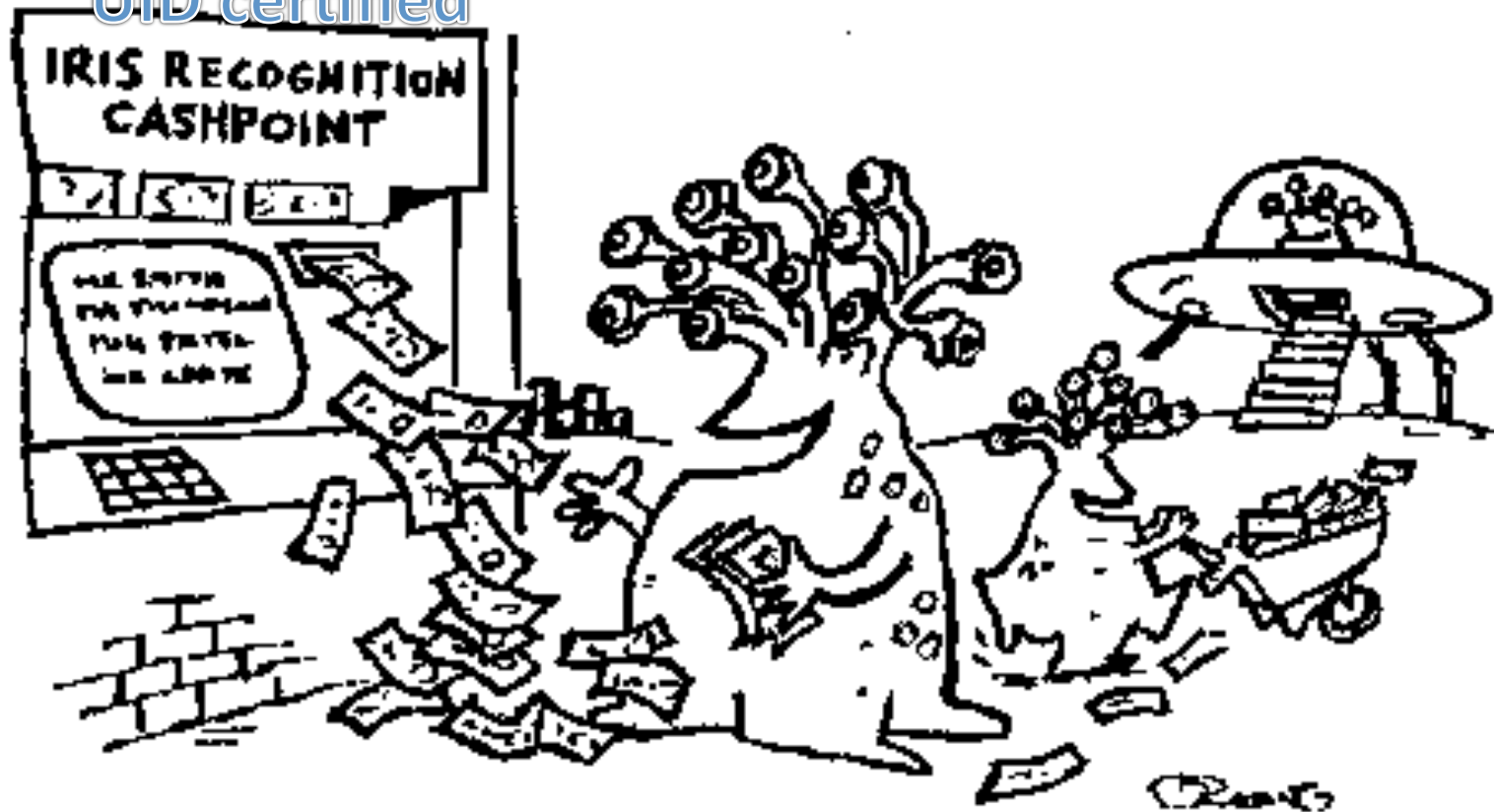


Conclusions

- Achievable Accuracy (for 98.2% of population)
 - FRR < 1% with two best finger fusion
 - FRR < 2.5% with one best finger
- More selective devices improve FRR by 2X
- Placement guide can also improve FRR materially
- PIV compliance insufficient indicator
- FAP 20 is necessary
- Throughput of 1M/hr is easily achievable
- Need for multimodal (iris) verification for inclusiveness and 10X accuracy improvement



UID certified



Why news about iris recognition triggered an alien invasion

References

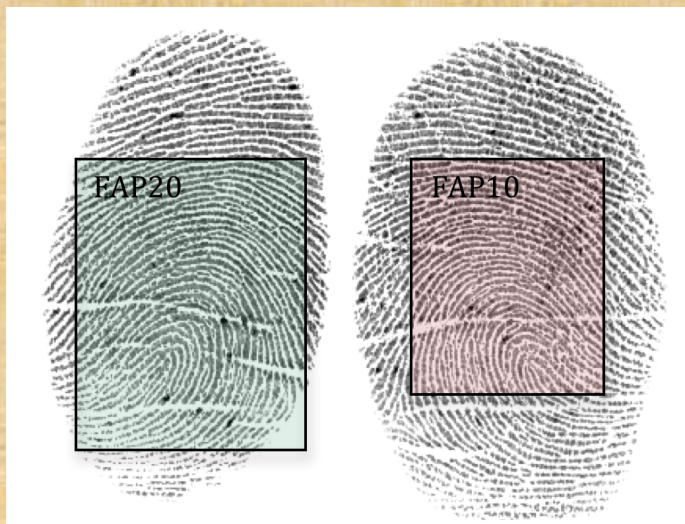
- Enrollment:
 - http://uidai.gov.in/images/FrontPageUpdates/role_of_biometric_technology_in_aadhaar_jan21_2012.pdf
 - http://uidai.gov.in/UID_PDF/Front_Page_Articles/Documents/Publications/Aadhaar_ABIS_API.pdf
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- Verification:
 - http://uidai.gov.in/images/FrontPageUpdates/role_of_biometric_technology_in_aadhaar_authentication.pdf
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 - http://stqc.gov.in/sites/upload_files/stqc/files/STQC%20UIDAI%20BDCS-03-08%20UIDAI%20Biometric%20Device%20Specifications%20Authentication_1.pdf
- UIDAI Documents
<http://uidai.gov.in/uidai-documents.html>



Backup



Finger placement



Excessive Pressure



Thumb: Enrollment & Verification

