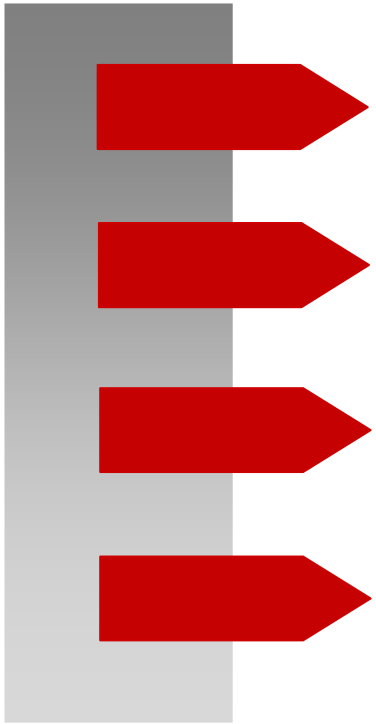
Federal Office of Administration

Federal Office for Information Security

Best Practice
Fingerprint Enrolment Standards
European Visa Information System

Improving performance by improving fingerprint image quality
Experiences from pilot project BioDEVII

Agenda



BioDEVII – Phase 1

Quality Improvements in Phase 2

ProVITA: Technical Evaluation of BioDEVII

Technical Guideline Biometrics for Public Sector Applications

The BioDEV II Project

- Gain experiences with regard to the introduction of VIS
  - Enrolment, Verification and Identification with focus on fingerprints
  - Organizational consequences for consulates and border posts
  - Interoperability of devices, processes and software
  - Ensure compliance with international standards

- 8 participating countries
  AT, BE, DE, FR (project manager), LU, PT, ES, UK

- Launched in 2007 and planned until the end of March 2010

Federal Office of Administration in BioDEVII

- AFIS Hosting
  - Consular Posts
  - Border Control
  - Belgium
- Fingerprint data exchange with other member states
- Dactyloscopic Service for
  - Consular Posts
  - Border Control
- Evaluation, Statistics, Monitoring
- Specification and Installation of Enrolment Solution

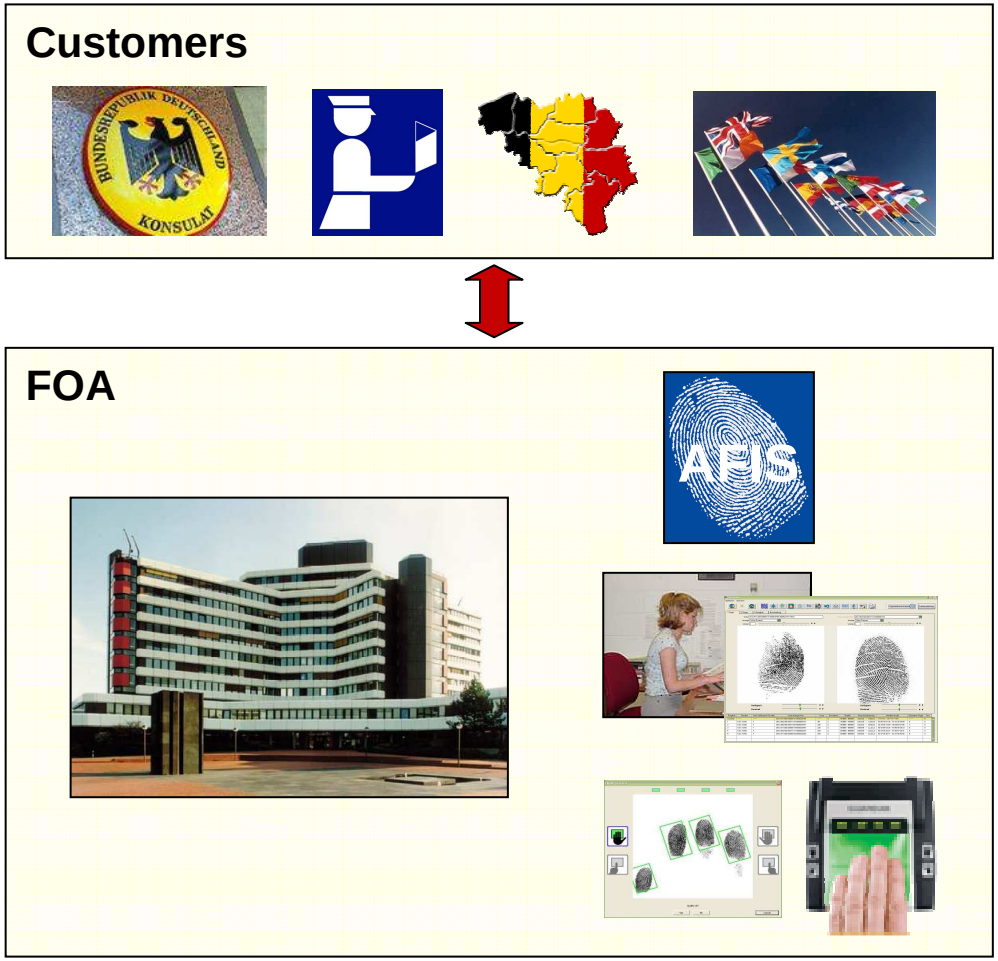


Image quality and performance

- Strive for *best* finger image quality
  - Quality (according to ISO/IEC 29794-1:2009)
    - Character of a sample
    - The fidelity of a sample to the source from which it is derived
    - The utility of a sample within a biometric system:
      An expression of quality based on utility reflects the predicted positive or negative contribution of an individual sample to the overall performance of a biometric system. Utility-based quality is dependent on both the character and fidelity of a sample. Utility -based quality is intended to be more predictive of system performance, e.g. in terms of FMR, FNMR, failure to enrol rate, and failure to acquire rate, than measures of quality based on character or fidelity alone.
- What's the meaning of quality within our AFIS setting?
  - Typical AFIS assumptions of the Biometric Matching System (BMS) of the EU VIS
    - Better quality of fingerprints yields to better AFIS performance
    - Use only fingerprints of a certain quality level: Enrolment performance is predicted by the Sagem quality control **USK 4**.
- Quality for the VIS practically means Sagem USK 4 quality
- How to enrol subjects within these constraints?

Enrolment Solution Phase 1

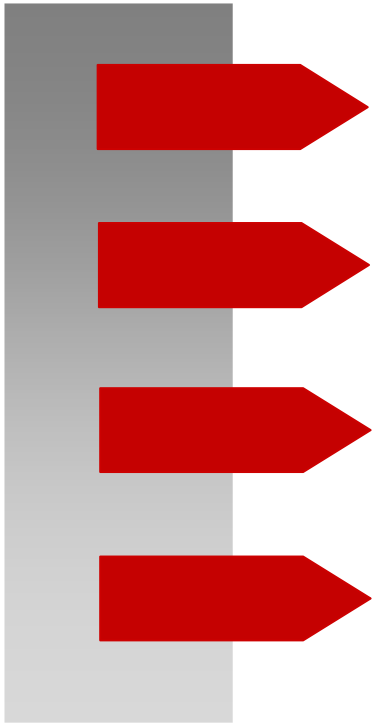
- Pragmatic Enrolment approach
  - Easy to use client
  - Quality Control with NFIQ
    - Good: 1, 2, 3
    - Bad: 4, 5
  - Operator tries to capture best fingerprints
- Training by Federal Foreign Office and Federal Office of Administration
- No Acquisition Guides, Training Material

Conclusion – Phase 1

- ~ 12000 fingerprints
- 2 German consular posts
- Assessing performance of the enrolment solution by analysing the Sagem quality control **USK 4** rejection rate.
- Rejection Rate: ~ 75% do **NOT** match minimum requirement for VIS
  - Damascus ~ 69%
  - Ulan Bator ~ 82%

- Possible conclusions
  - Simple NFIQ is not enough!
  - VIS BMS QA (USK 4) has to be implemented in Client?
  - Training not enough?
  - VIS BMS QA is too strict?

Agenda



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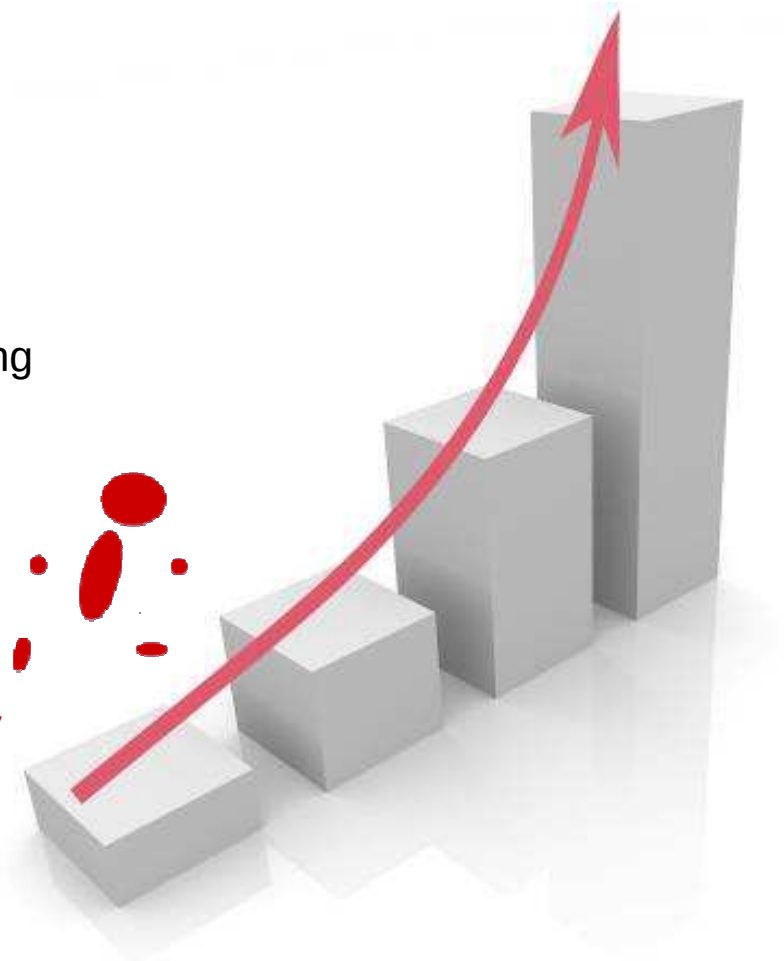
Technical Guideline Biometrics for Public Sector Applications

Improving performance by improving fingerprint image quality

- General mechanisms
  - E.g. training, acquisition guides, auxiliary utilities
- Hardware improvements
  - E.g. silicon pads, feedback monitor, sensor positioning
- Software / workflow improvements
  - E.g. iterations, feedback, algorithms
- **All elements are necessary to achieve suitable quality**



Training & Information Material

- Training for operators
  - Acquisition guides
  - Training videos
  - Personal training of operators
- Instructions for applicants
  - Preparation by guidance poster
  - Video instructions

Hardware Improvements

- Fundamental: Use high quality capture device
  - Technical Guideline (TR-03104) from BSI (**www.bsi.de**)
  - Fingerprint scanners certified according to TR-03104
    - Certified single finger scanners (2009)
      - Cross Match, Sagem, Dermalog, Green Bit
    - Certified four finger scanners (2009)
      - Cross Match, L1 Identity
- Feedback monitor for applicants
  - Pro: Support finger positioning by direct feedback
  - Contra: Expensive and space requirement

Enhancers

- Enhancers to improve image quality & contrast
  - Silicon pads
    - Contra: Regular exchange necessary, Requires recalibration
  - Pre-Scan
    - Contra: Regular cleaning of device necessary
    - Contra: Health check?

Ergonomics

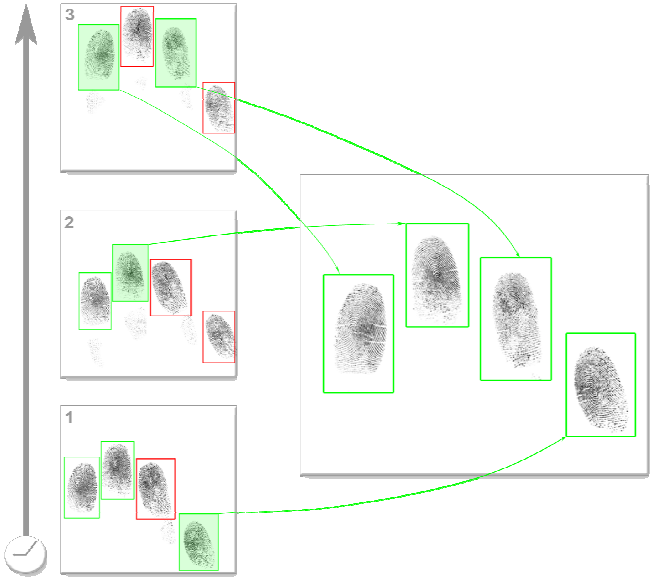
- Sensor positioning
  - **Height**: BRIDGE recommends scanner at elbow height
    - TRUE BUT**:**
      Operator cannot see hands during capture process
      → No manual False Finger Detection!

  - **Angle**: BRIDGE recommends central position of scanner, so that angle is comfortable for both hands
    - TRUE BUT:
      Not always possible because of local restrictions!

Software / Workflow Mechanisms

- Build composite records out of multiple captures
  - Option 1: choose best fingerprint by fingerprint cross matching
  - Option 2: choose best fingerprint by QA algorithm (e. g. Sagem, NEC, NFIQ)
  - Thresholds have to be configurable!

- Switch to single finger mode for difficult fingers
- Enforce strict workflow to avoid early overrule by operator



2 Improved Enrolment Solutions – Main differences

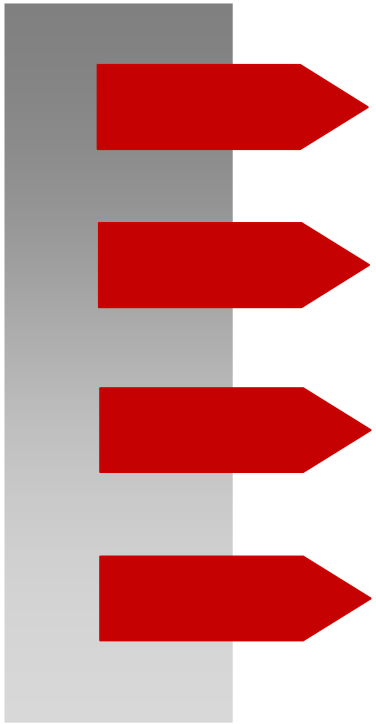
secunet

- Usage of auto-capture
- 3 times putting slaps on scanner
- Always whole slap is captured
- QA Sagem Kit4 included
- Open Source NIST QA & segmentation
- Cross matching used for composite record (3 slaps min.)

NEC

- No auto-capture, NEC QA controls
- Slap stays on scanner
- Switch to single-finger capturing
- QA Sagem Kit4 included
- NEC QA and segmentation algorithms
- NEC QA for composite record

Agenda



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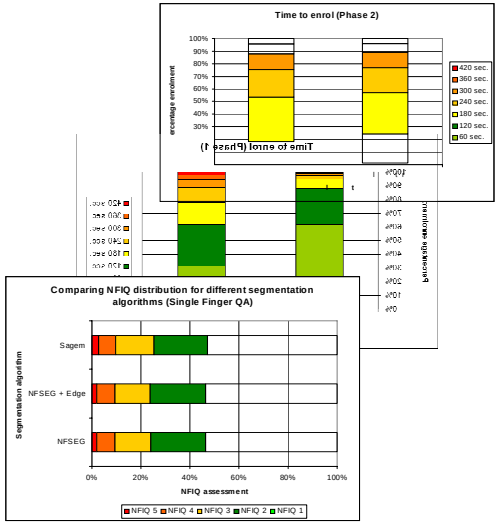
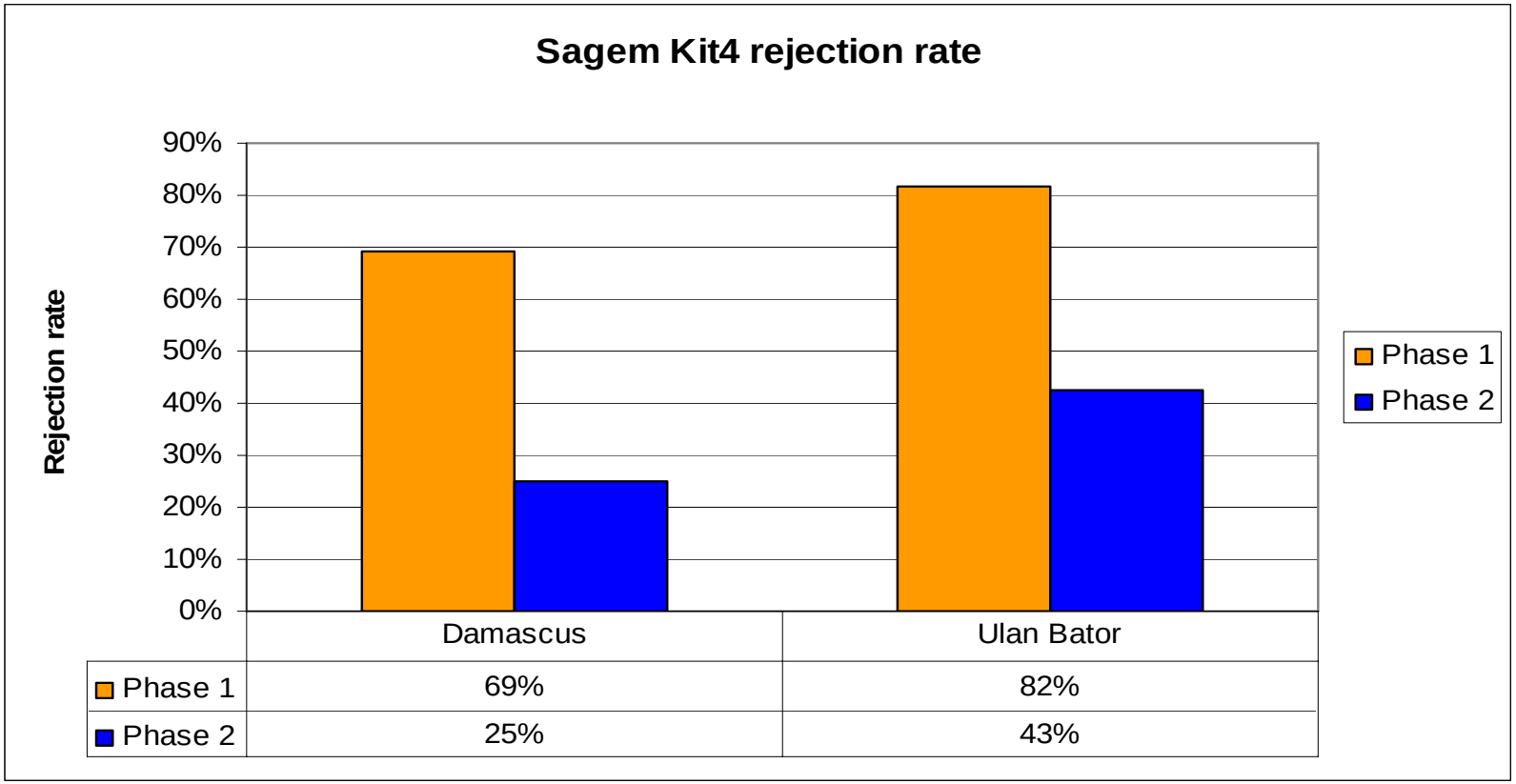
Technical Guideline Biometrics for Public Sector Applications

ProViTA: Technical evaluation of BioDEV II

- Data from October 2007 to August 2009
- Qualitative **performance analysis** of the enrolment solutions
- Simulation of alternative **QA and segmentation algorithms**
- Derivation of **best practices** while considering the interests of all stakeholders
- Solid foundation for the **Technical Guideline Biometrics**



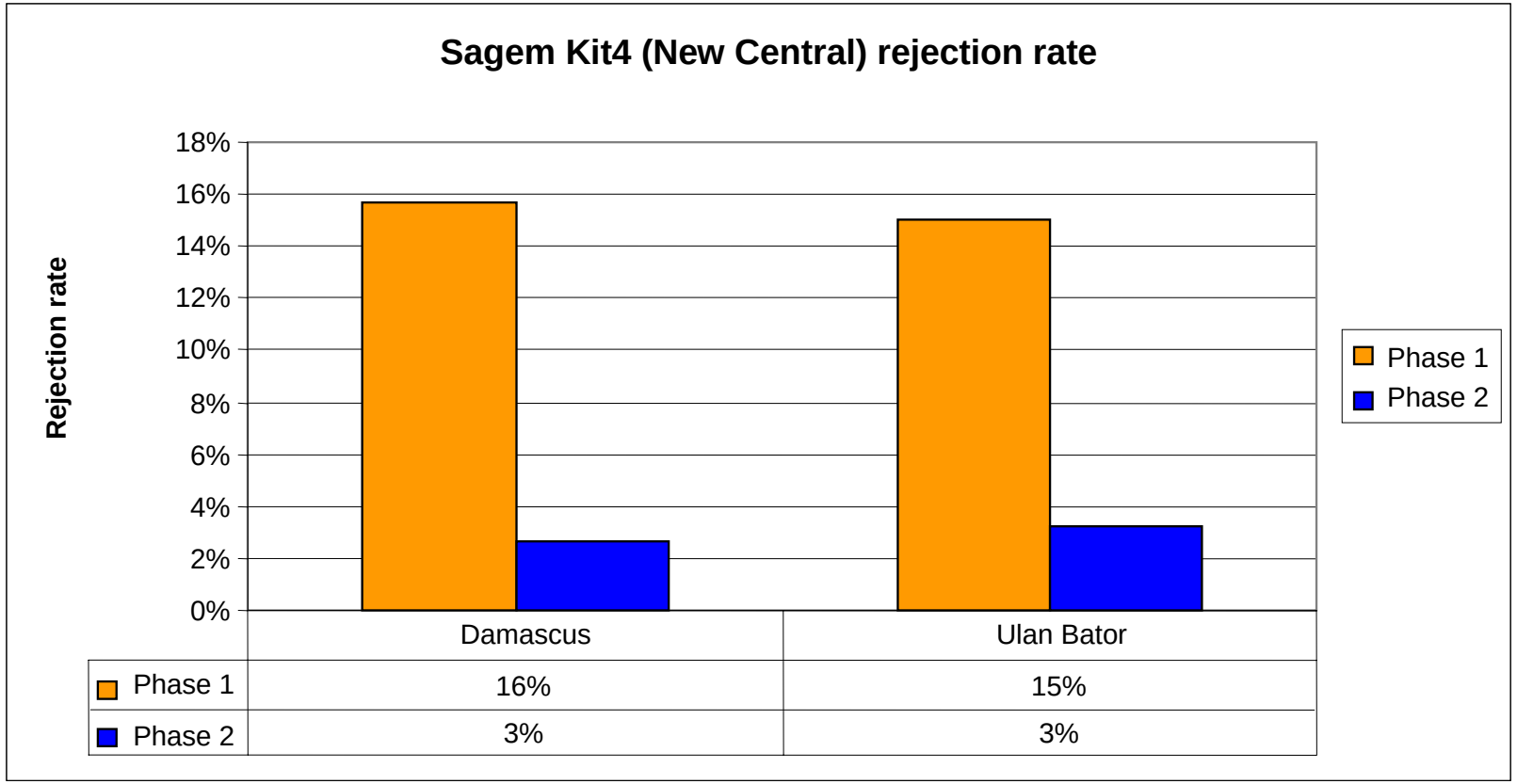
Results: Fingerprint Quality - Classic Rejection Rate



	Damascus	Ulan Bator
Phase 1	69%	82%
Phase 2	25%	43%

- Significant decrease of Kit4 rejection rate in Phase 2 (up to one third)

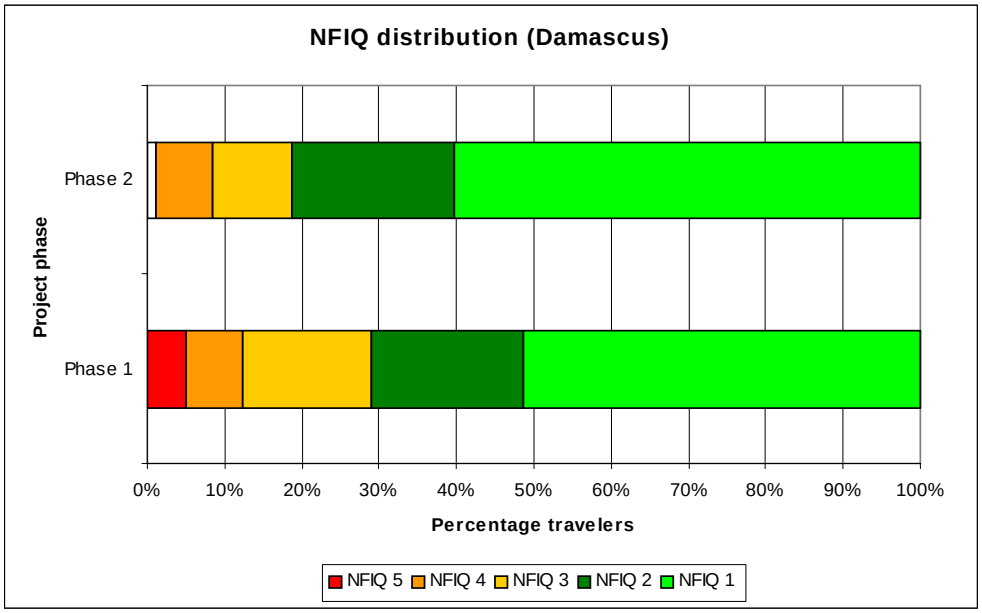
Results: Fingerprint Quality - New Central Rejection Rate

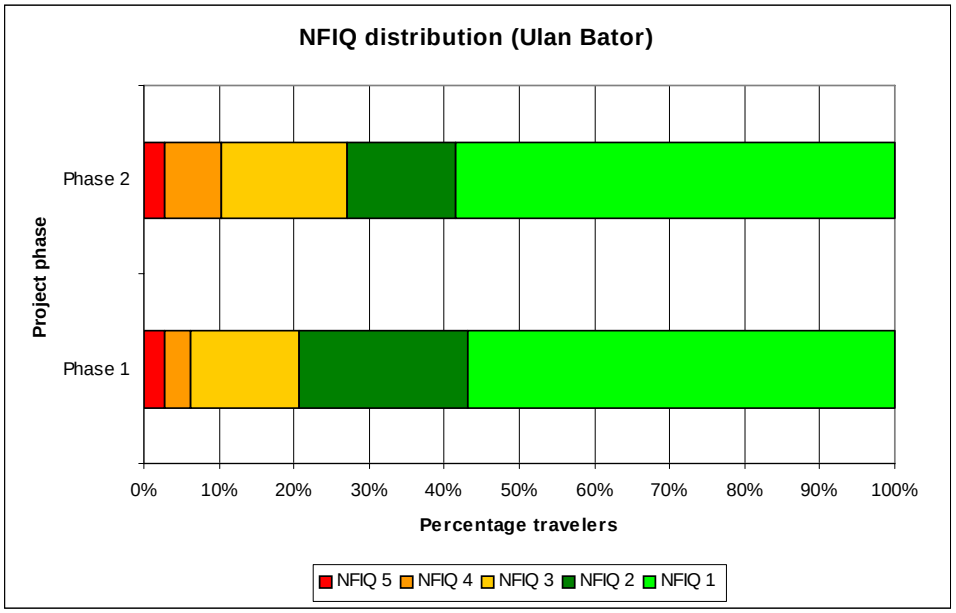


- Much lower rejection rate for new Central Kit4

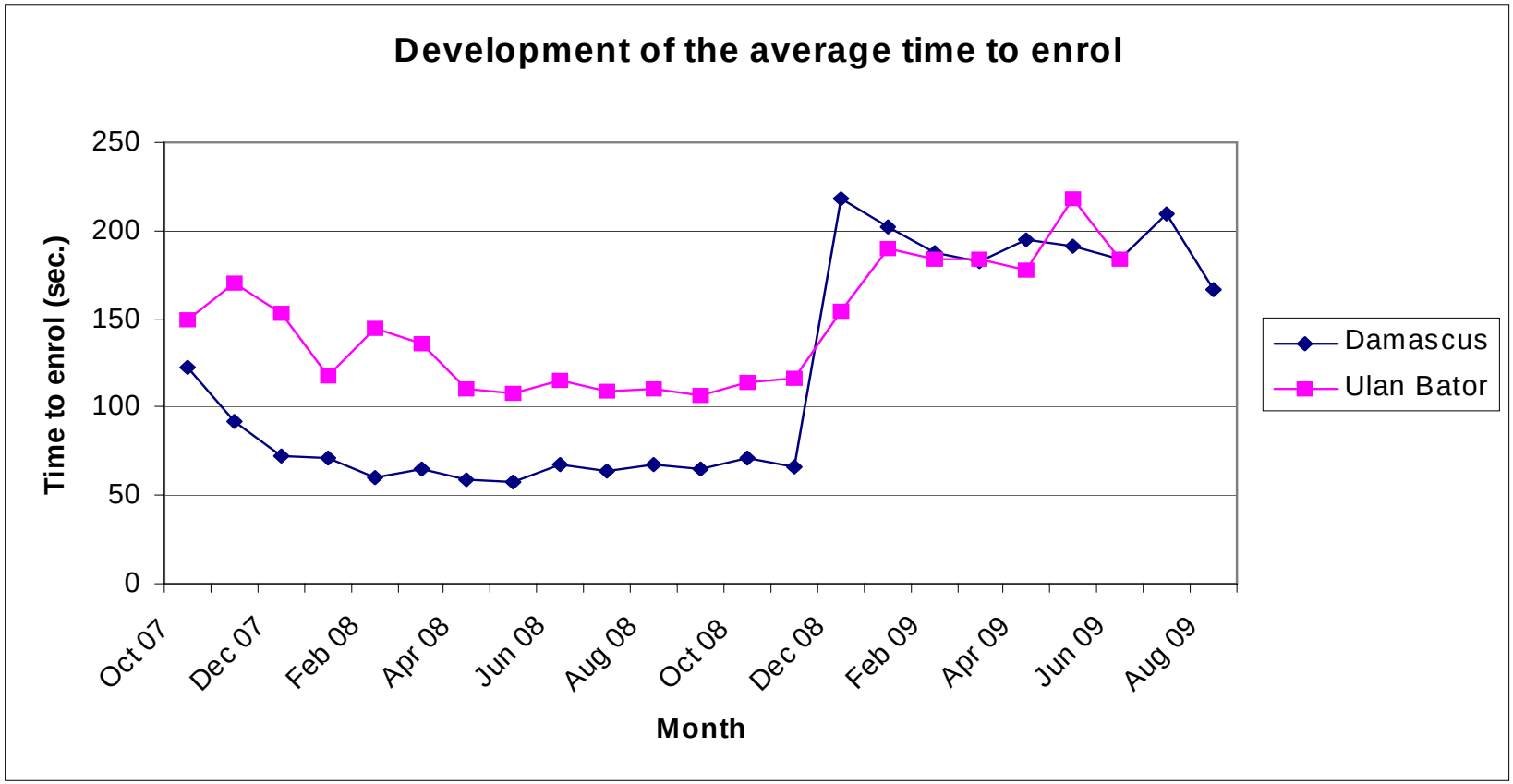
Fingerprint Quality Distribution for third party QA algorithms

- Quality assessment on all enrolled fingerprints was performed using NFIQ, Sagem Kit4, NEC QualityTool, Aware SequenceCheck
- Damascus records noticeable quality improvement of captured fingerprints for all algorithms. In Ulan Bator, the opposite is consistently the case.





Results: Enrolment Duration



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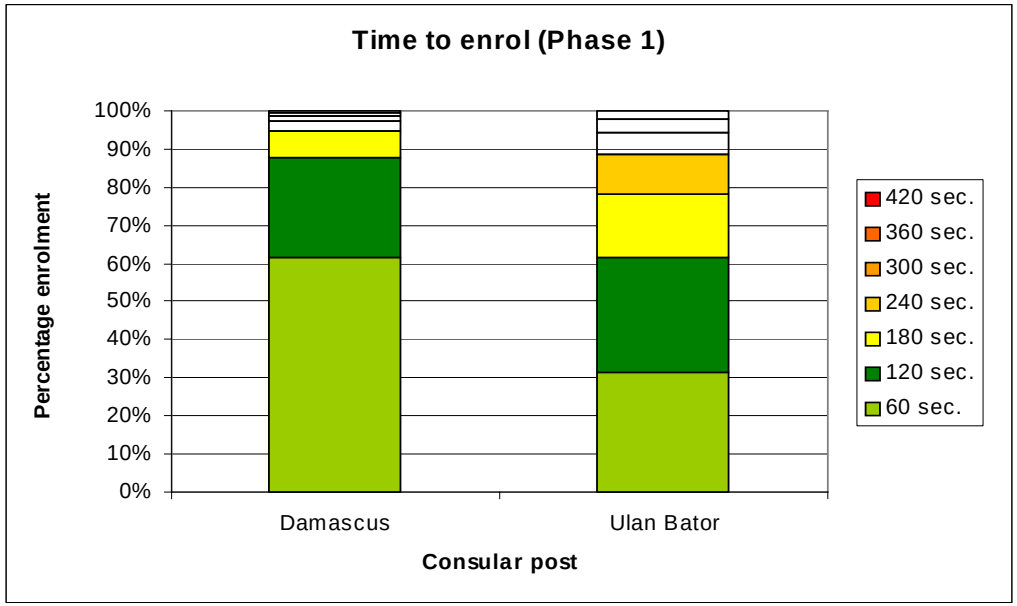
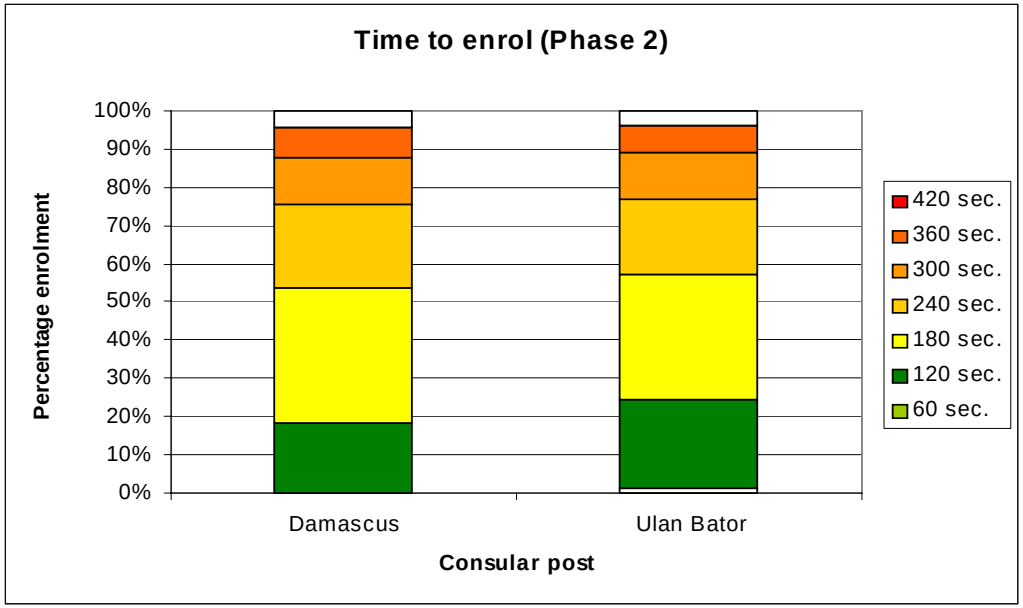
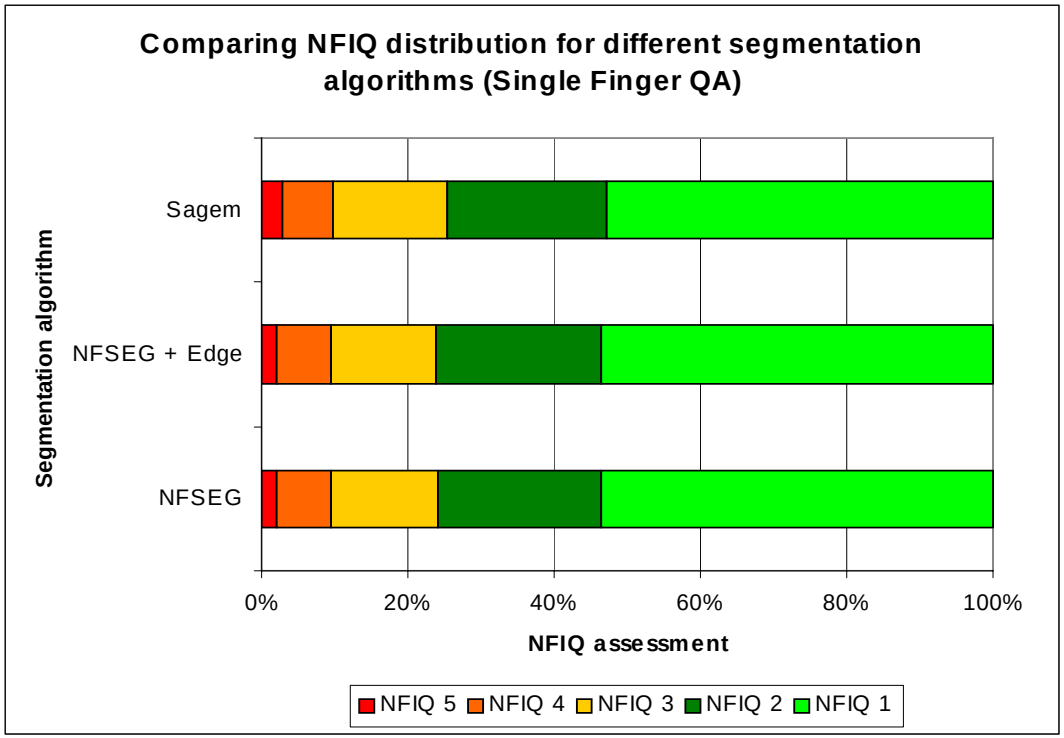




- **Phase 1**
  - 90% / 60% of enrolments in less than 120 sec.
- **Phase 2**
  - 75% of enrolments in less than 240 sec.
  - Almost no enrolment in less than one minute

Results: Influence of Segmentation algorithm

- Slaps were segmented using different algorithms
  - NFSEG, parameterized NFSEG, Sagem Morphos
- QA on resulting fingerprint images
  - NFIQ, NEC QualityTool, Aware SequenceCheck, Sagem Kit4
- Result: segmentation has little to no impact on image quality
- Open source solutions offer equal or better performance



Interoperability of Segmentation algorithms

- 4-Finger-Slap captured with Cross Match LSCAN Guardian Sensor

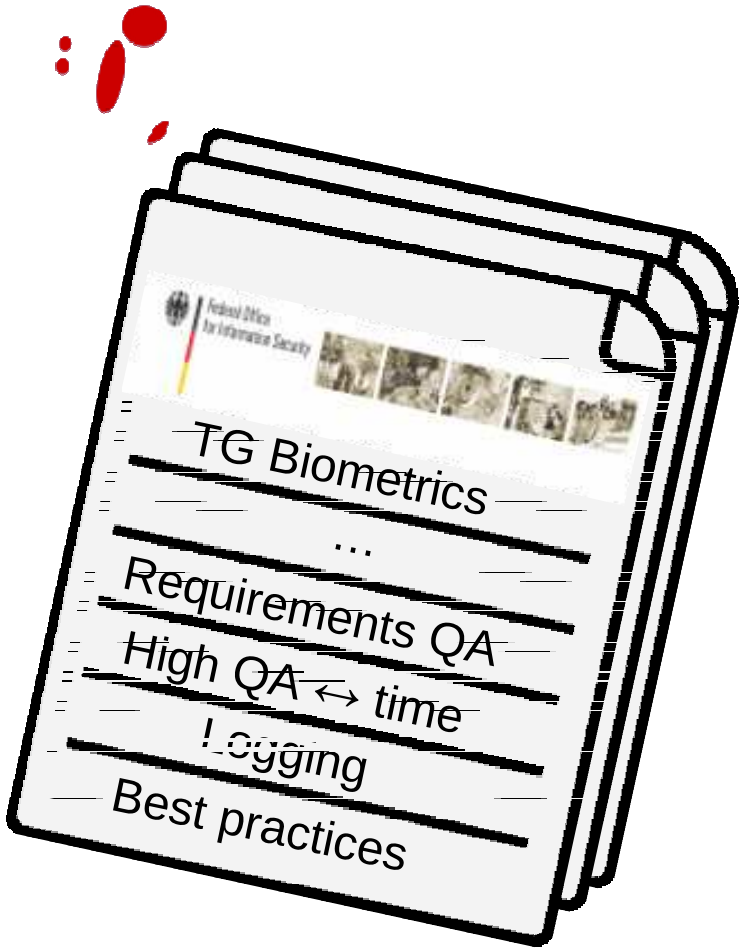
Interoperability of Segmentation algorithms

NFSEG

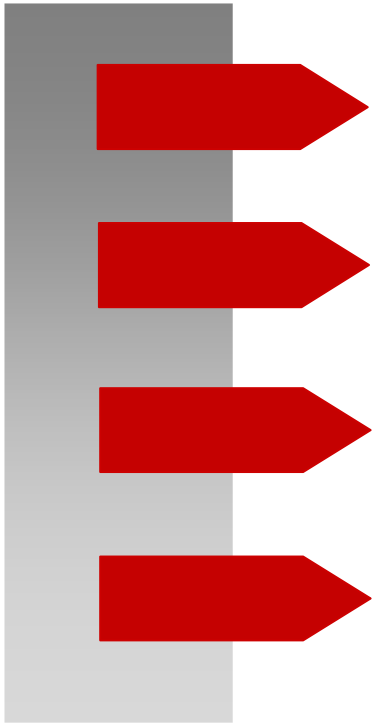
BMS-VIS USK3

Lessons Learned

- **Quality assurance** has a **large impact** on the overall process
- Good quality can only be achieved as a **combination of operational and software-based** quality measures
- **High quality** comes at a price (**enrolment time**)
- You can learn how your system works if you have enough **logging data**!
- Need for specifying **best practices** for high quality enrolment processes



Agenda



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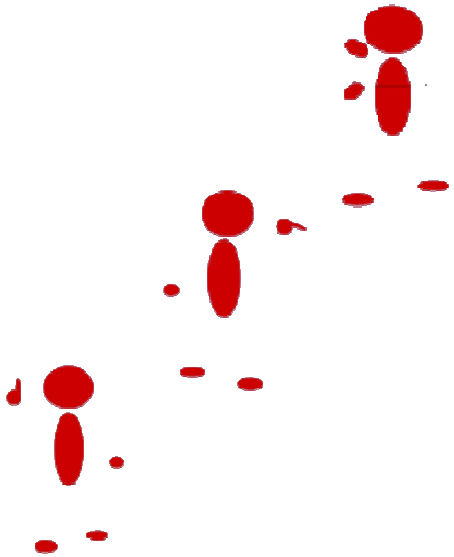
Technical Guideline Biometrics for Public Sector Applications

Why a Technical Guideline?

Biometric *Lessons Learned* exist: they have to be made reusable



Project Leaders: preparing a call for tender

End Users: requesting Quality

Companies: general requirements and standards

All biometric processes are – roughly – the same

Typical Enrolment Workflow (e.g. for VISA)

Specify distinct requirements

- Process description for high quality fingerprint enrolment

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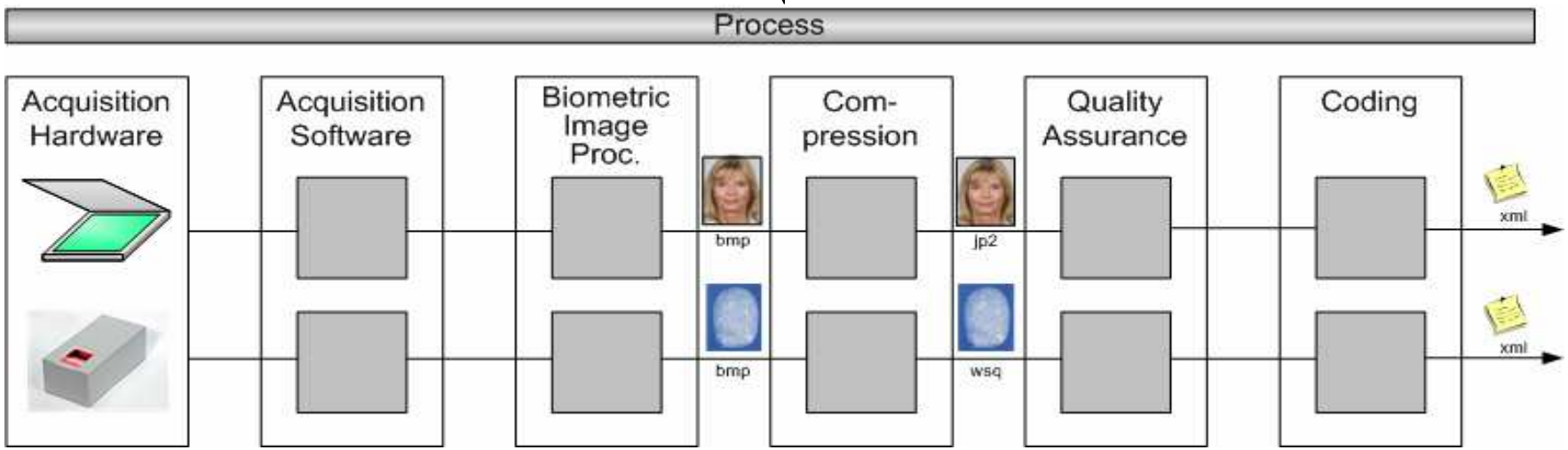
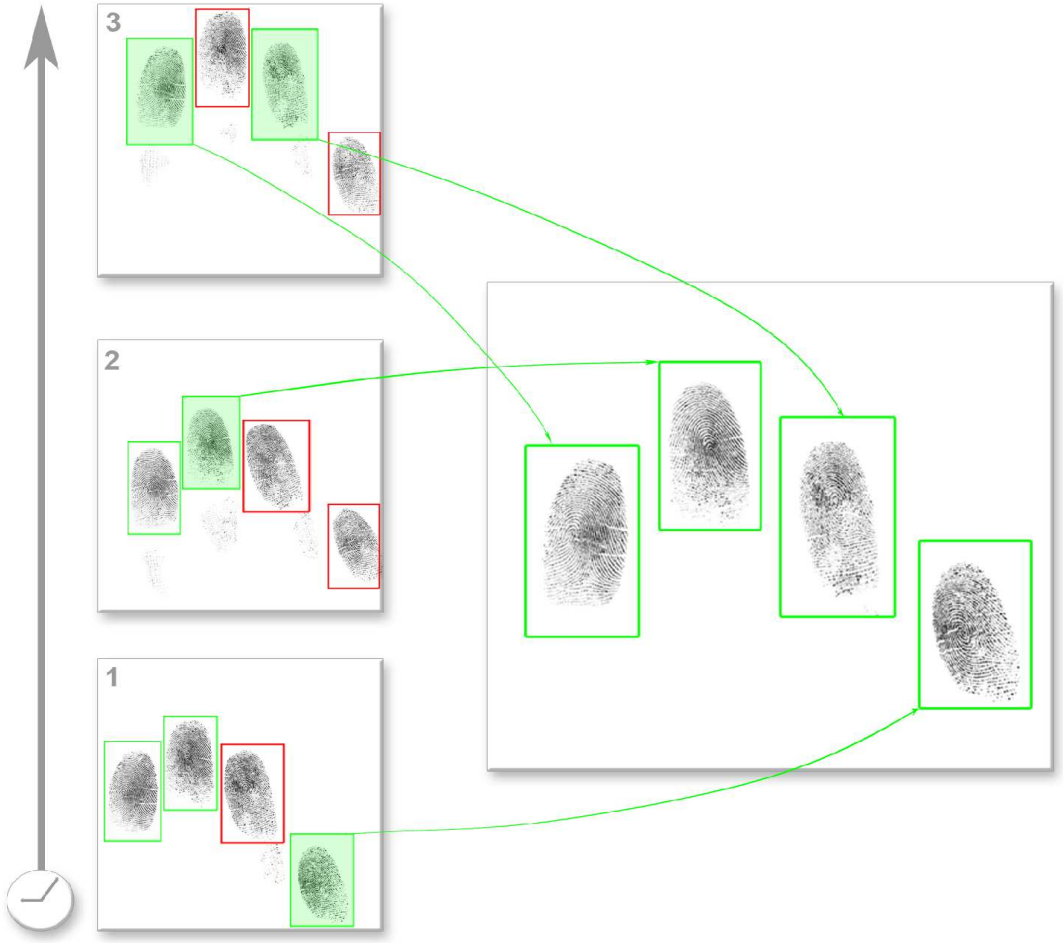


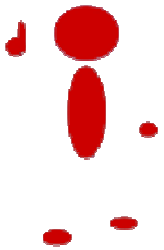
VISA Enrolment Profile: Fingerprint process requirements

- Based on composite records
- Several QA mechanisms possible
- Proposed QA is a 3-way crossmatching of fingerprints
- re-capture of single fingers possible, if necessary



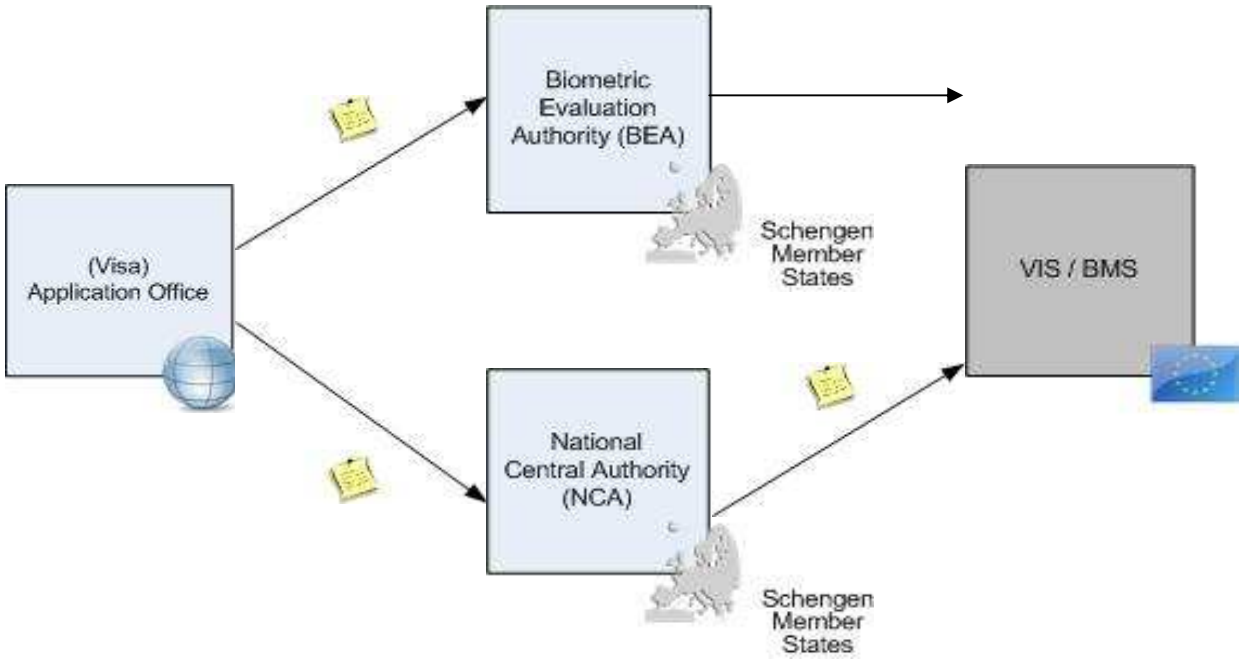
VISA Enrolment Profile: Other aspects

- Collection of recommendations that were established while running the BioDEV II project
  - User guidance
  - Operator guidance
- The guideline has information on the coding
  - of the biometric data itself plus additional data
- Data to collect (Function Module **Logging**)
  - Quality values, HW/SW information, timing information if possible, errors, demographic data
- Only **Logging data** provides information
  - Analyse failures, increase of the rejection rate etc.
  - Discover possible optimisations
  - Monitoring system performance in quality and time



VISA Enrolment Profile: Data Flow Overview

- Biometric data is collected for the VIS through the NCA
- Additional quality data is collected for evaluation purposes by the Biometric Evaluation Authority (BEA)



Currently Available Specifications

- Visit the Homepage of the

  Federal Office for Information Security
  Bundesamt für Sicherheit in der Informationstechnik - BSI

- http://www.bsi.bund.de/ElektronischeAusweiseTR | TR-03121
- Version 1.0.1
  - Enrolment profile German Identity Card
- Version 2.0
  - Additional enrolment profile VISA enroment
  - Available as release candidate
- Version 2.x
  - More application profiles

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Thank you for your attention!