



NIST Biometric Quality Workshop 2007

Next Generation German e-Passport Fingerprint Enrolment – Quality vs. Time



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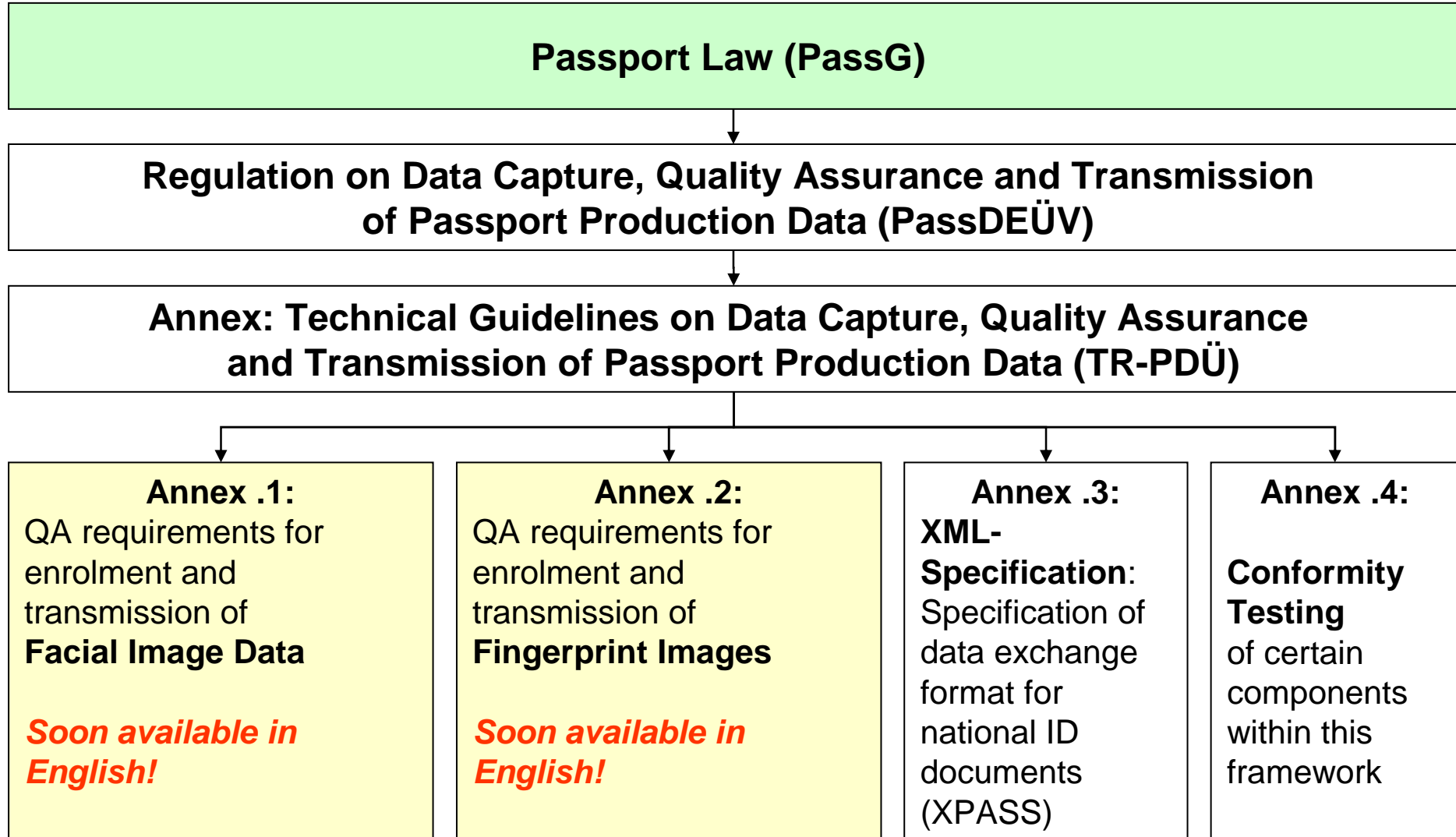


Overview

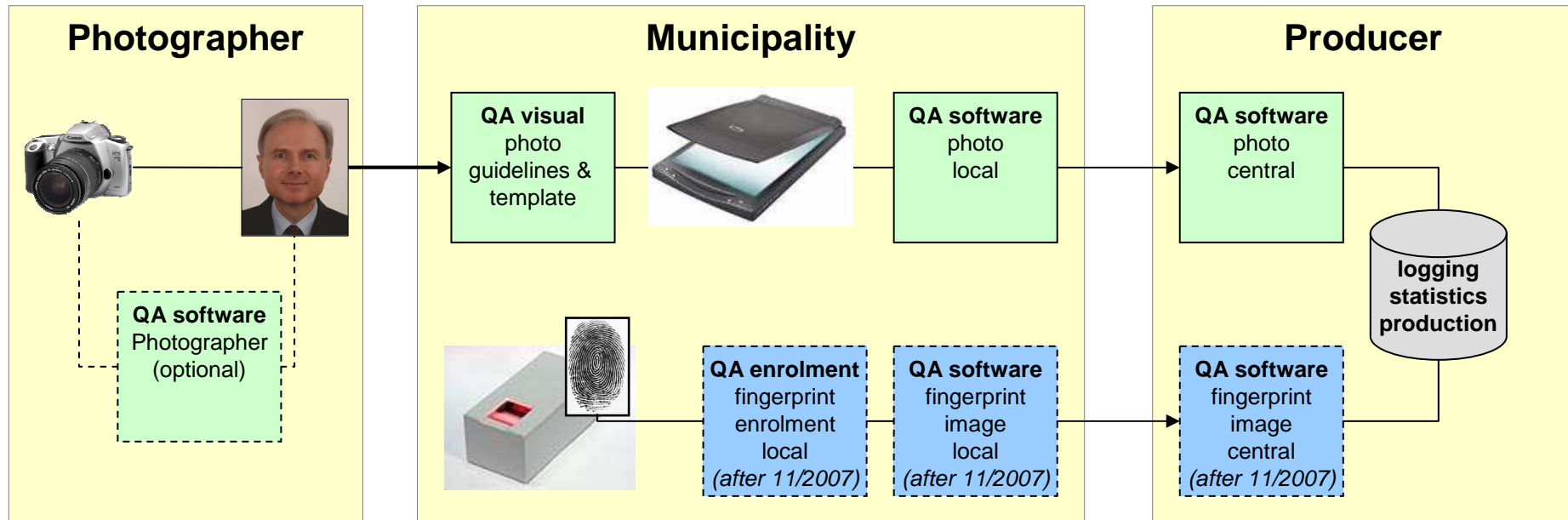
- Introduction
- Legislative framework
- Workflow for enrolment of biometric features in Germany
- Quality assurance of fingerprints
 - Quality requirements for sensor hardware
 - Quality requirements in the enrolment process
- Results of recent pilot testing
- Summary



Legislative Framework



Quality assurance within the enrolment process



- For interoperability, the facial image (and later the fingerprints) have to comply to ISO and ICAO standards
- A 3-phase Quality Assurance process is implemented in 5300 municipalities:
 - new photo guidelines
 - new photo template
 - QA software for facial images and fingerprints



Preparations for large scale fingerprint enrolment



Overview fingerprint enrolment

- **Major differences compared to facial image enrolment**
 - in municipal offices, only digital enrolment is imaginable
 - visual inspection (i.e. QA of fingerprints) is not feasible
 - Fingerprint enrolment is completely new for citizens and officials alike
 - E.g., how to place a finger on a scanner?
 - Possibility of *Failure to Enroll* → regulations for exceptions have to be in place
 - electronic transmission only (no paper form fall-back)
- **Challenges**
 - no standard on high quality fingerprint enrolment available
 - certified hardware for 4-finger devices only
 - infrastructure needs, integration in local systems

Development of (national) quality requirements

- **Motivation for the development of quality requirements for sensors**
 - Only single finger fingerprint sensors for municipalities (cost, footprint)
 - Impossible to predict
 - the reference sensor at the time of verification nor
 - the reference matcher
 - therefore need to create highly interoperable images (for use at least throughout the European Union)
- **Solution: apply existing and proven standard (EFTS/F) and adopt it to single finger fingerprint sensors**
- **Create national certification scheme for those sensors**



Requirements for enrolment hardware

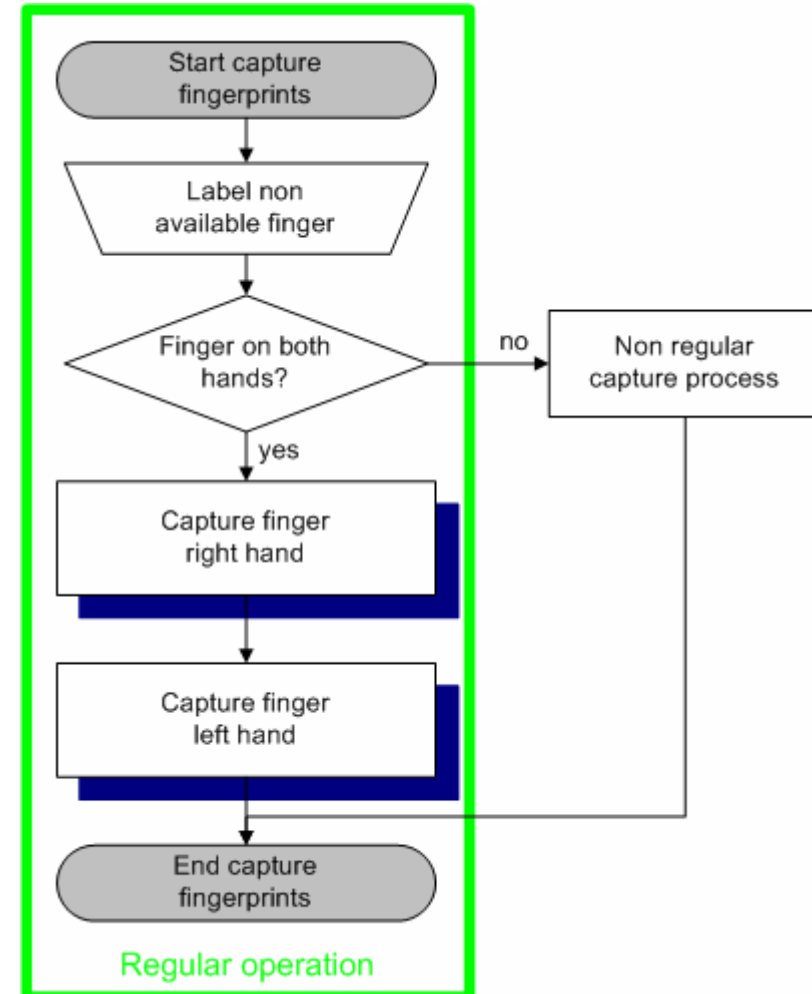
- Optical fingerprint scanner with 500 dpi or 1000 dpi (19794-5 Level 31/41)
- Compliance to the FBI's Electronic Fingerprint Transmission Standard, App F (EFTS/F)
 - Acceptable deviations regarding sensor size for single finger scanners (at least 16mm x 20mm)
 - Compatible to BKA requirements for AFIS, VIS and Fast-ID
 - Conformity report of the vendor
 - Pre-tests at the BKA
 - BSI certified conformity (similar process to CC evaluation): independent testing by accredited testing lab



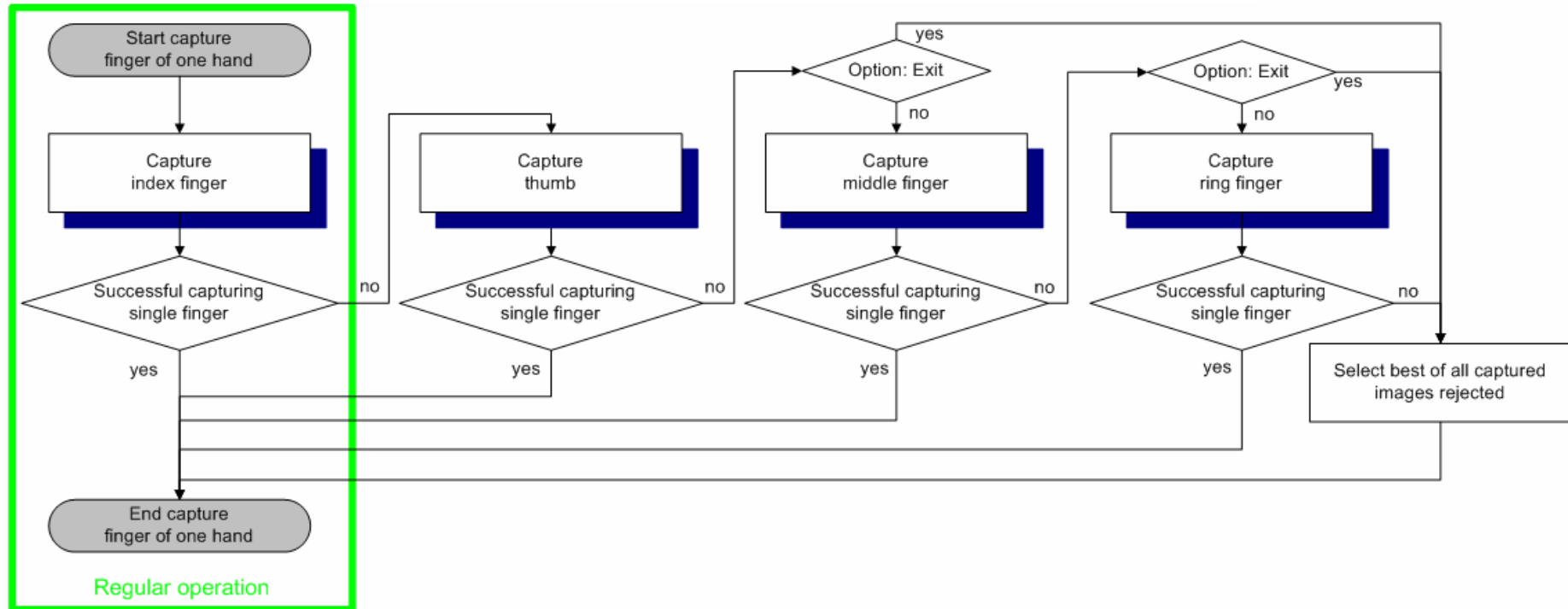


Enrolment process overview

- The standard process is the enrolment of two fingers, one from the right and one from the left hand.
- Fingers which are not available (e.g. due to injuries or handicaps) are not part of the standard process.
- If there is only one hand available, then only fingers from this hand will be enrolled.
- It is up to the official to decide if a finger is suited for enrolment or not.



Enrolment of one hand

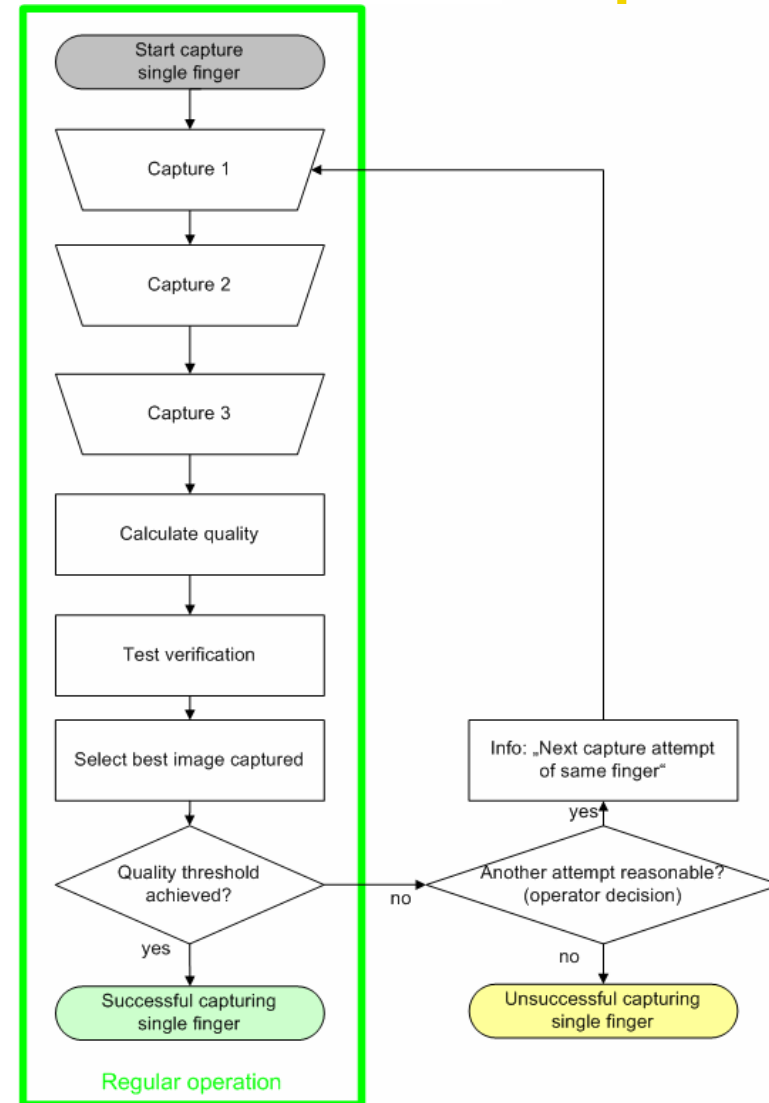


- Pre-defined order: index finger → thumb → middle finger → ring finger
- Mandatory process: one has to try two fingers of one hand before the option to switch to the other hand is opened.
- From each hand, the best (according to our quality scoring) finger is selected for storage.



Enrolment of a single finger

- From each fingerprint, three separate images are captured (by placing the finger three times on the scanner).
- For each image, the quality score is calculated.
- The systems matches the three images against each other to avoid substitutions.
- The best image, according to match score, is selected for storage.



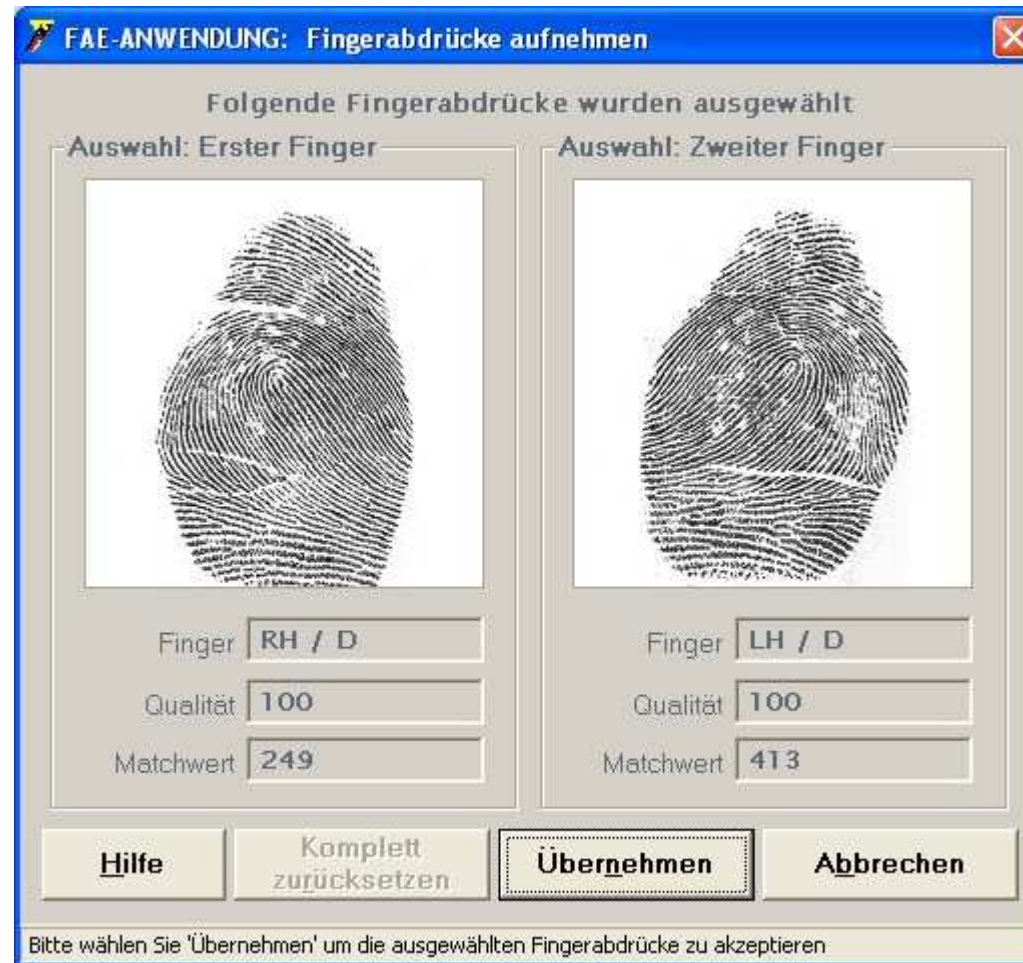


Live-Demo Fingerprint-Enrolment-Software 1/2





Live-Demo Fingerprint-Enrollment-Software 2/2



Enrolment process: QA-software

1. The software has to model the control flow so that the fingers are taken in the correct order
2. Pre-qualification of single fingerprints by NIST NFIQ algorithm
3. There is always a series of 3 enrolled images per finger
4. Choose the image with the best Bozorth3 reference match score average

Why?

- Existing possibility of taking several images at enrolment (quality vs. time)
- When you have to choose between several similar images, NFIQ won't help you (tests have shown that in most cases, all three fingerprints have the same NFIQ value)
- Solution derived from a set of about 70,000 fingerprints (from over 1,100 persons with 3 different sensors in autumn 2006)

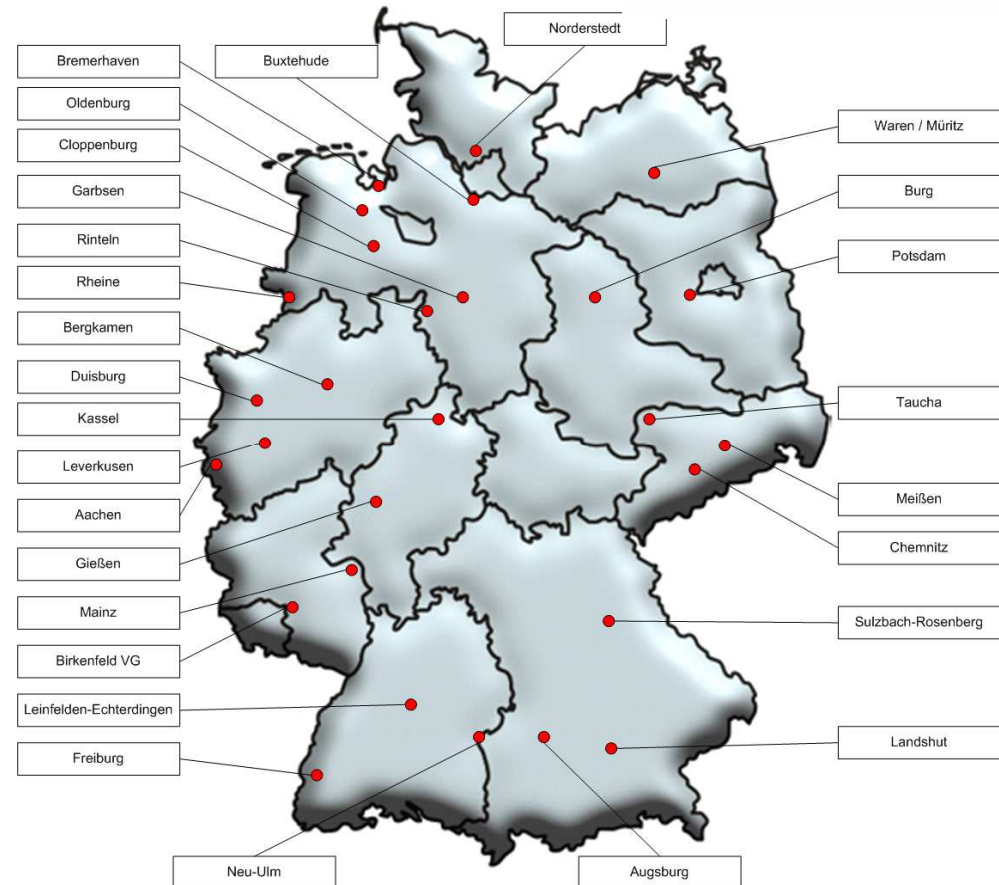
Pilot Testing





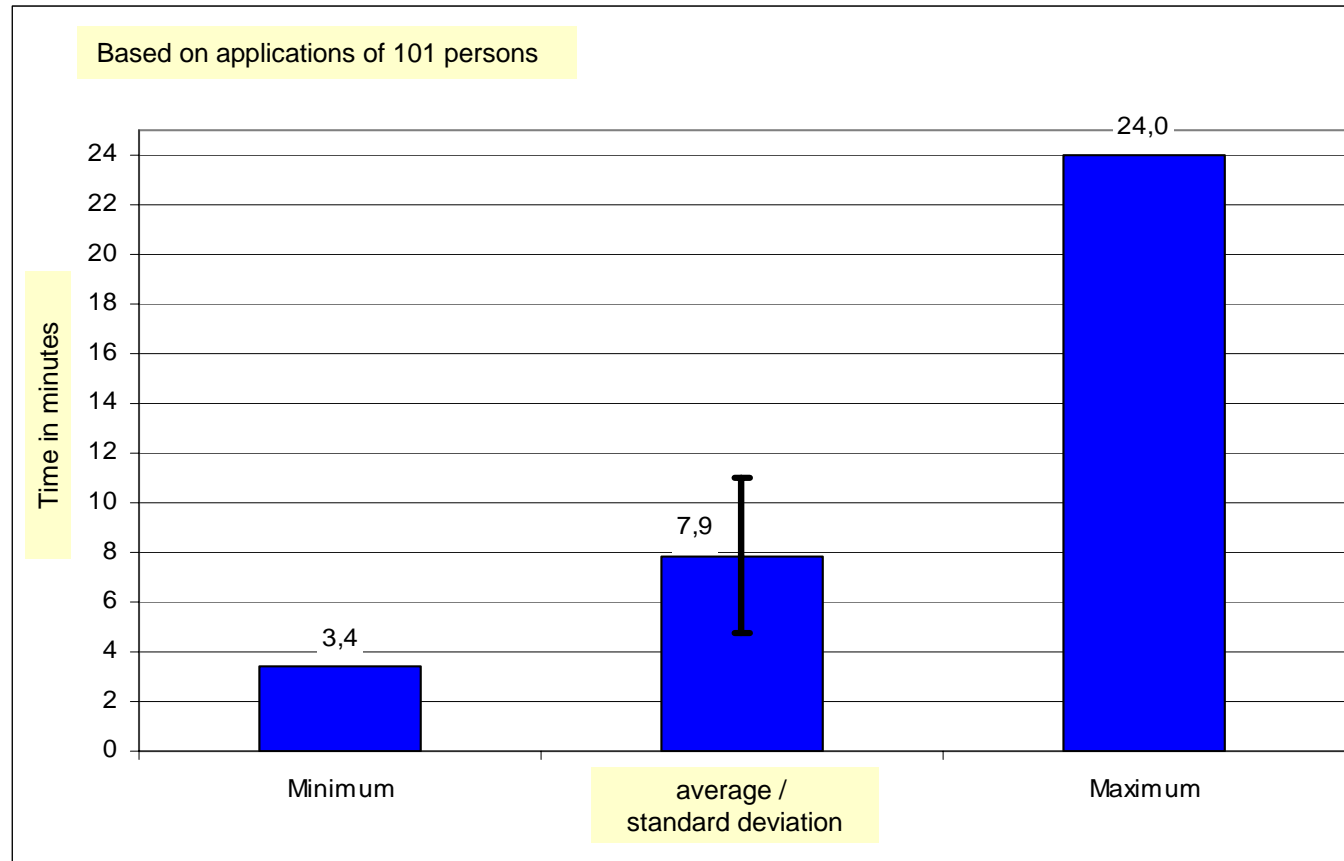
Pilot testing: overview

- Final goal: functioning enrolment software, secure transmission, import into production systems, production of e-passports incl. FP for 5300 municipality offices
- Preliminary legislation in place for testing purposes (citizens in participating communities have to apply with fingerprints!)
- Participation of >28 municipality offices
- Cross section of all types of infrastructures (client/server, Citrix, PC, ...) and all major software vendors
- Participants: MOI, BSI, BKA, Bundesdruckerei, vendors, offices





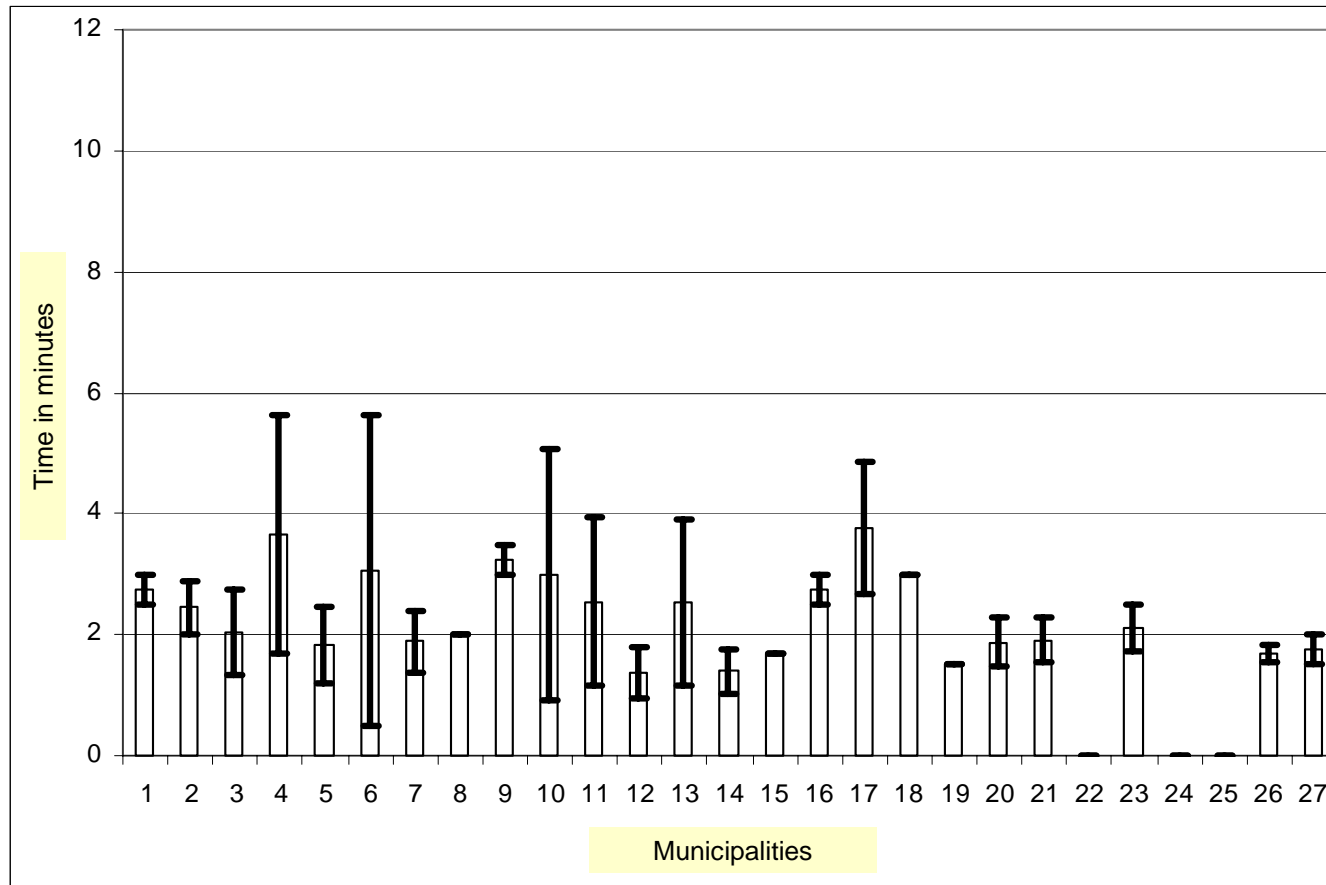
Timing considerations (1)



- Average time to **apply for an e-passport**: 8 min (based on 101 persons)
- Minimum: 3.4 min / Maximum: 24 min



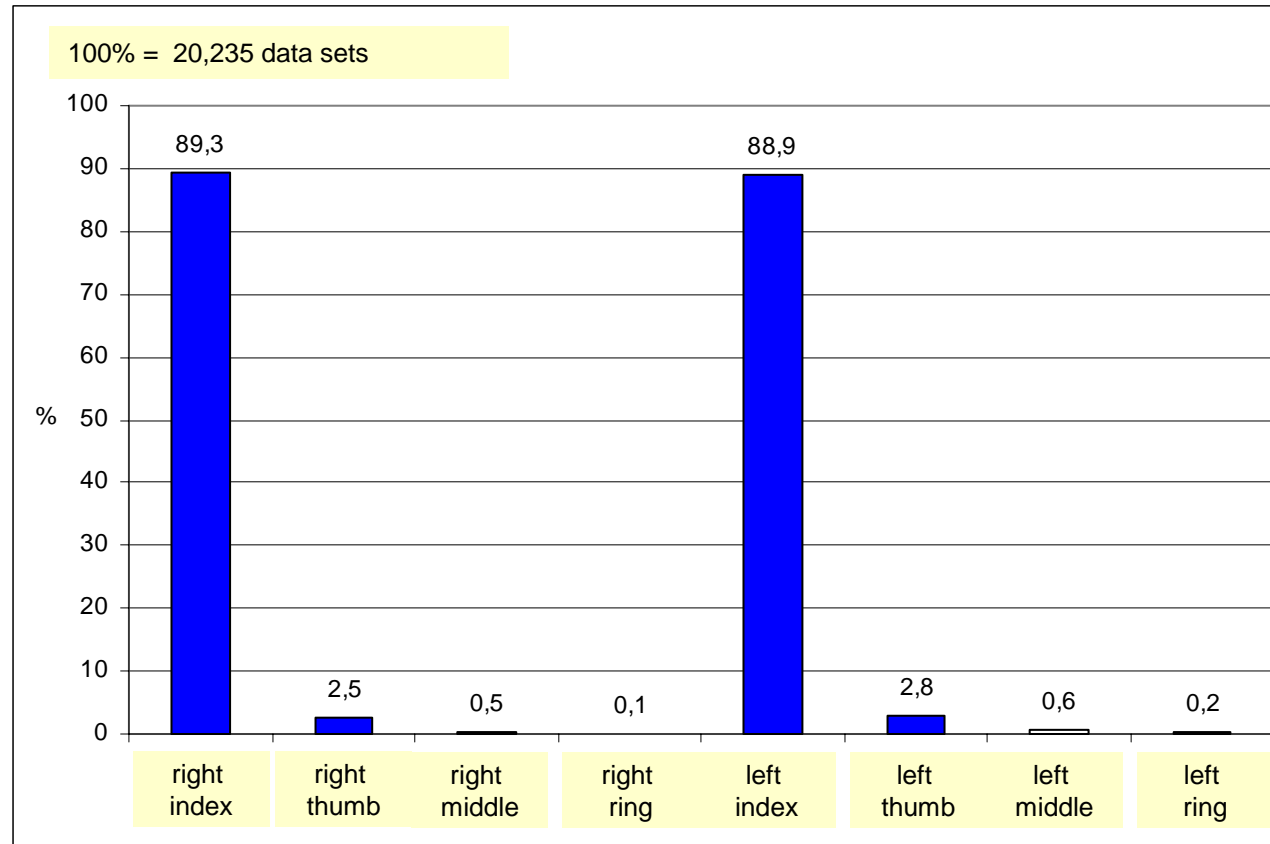
Timing considerations (2)



- Average time to **enrol two fingerprints**: 2.3 min (based on 112 persons)
- Minimum: 42 sec / Maximum: 11 min



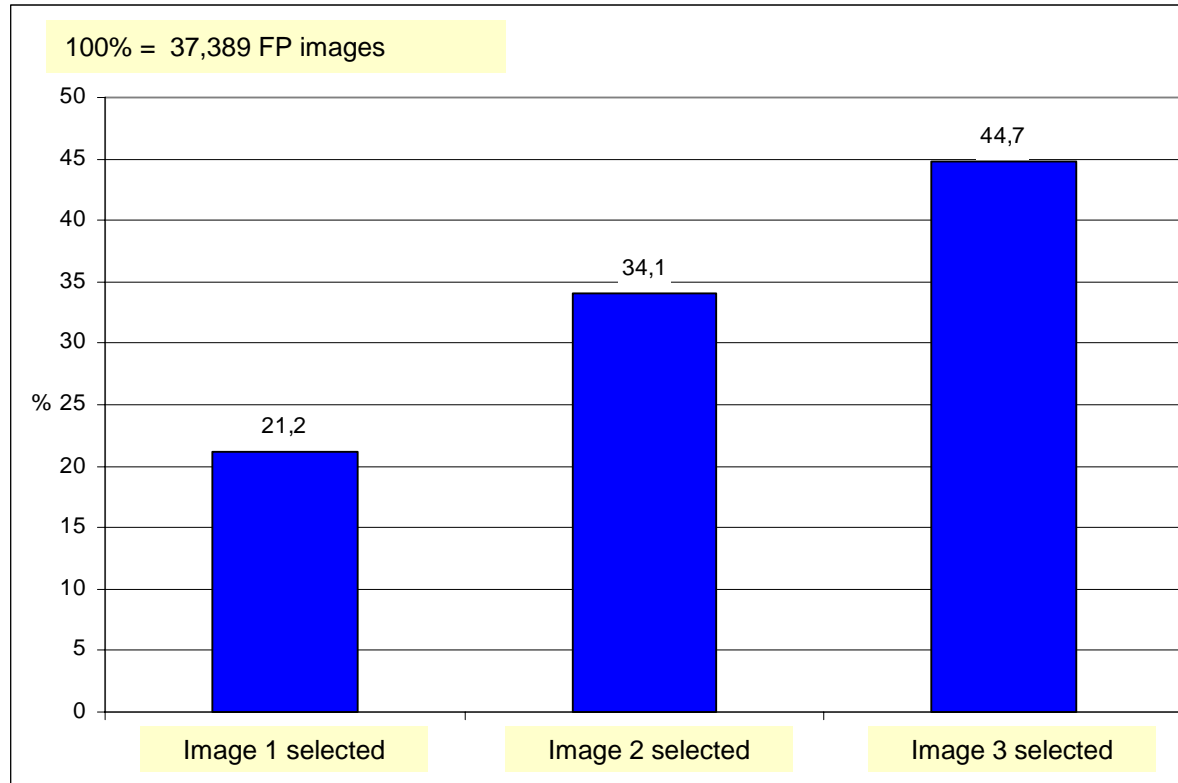
Fingers finally selected for e-passport storage



- In 90% of all cases, the index fingers were successfully enrolled
- Order during the test: index – thumb – middle – ring finger



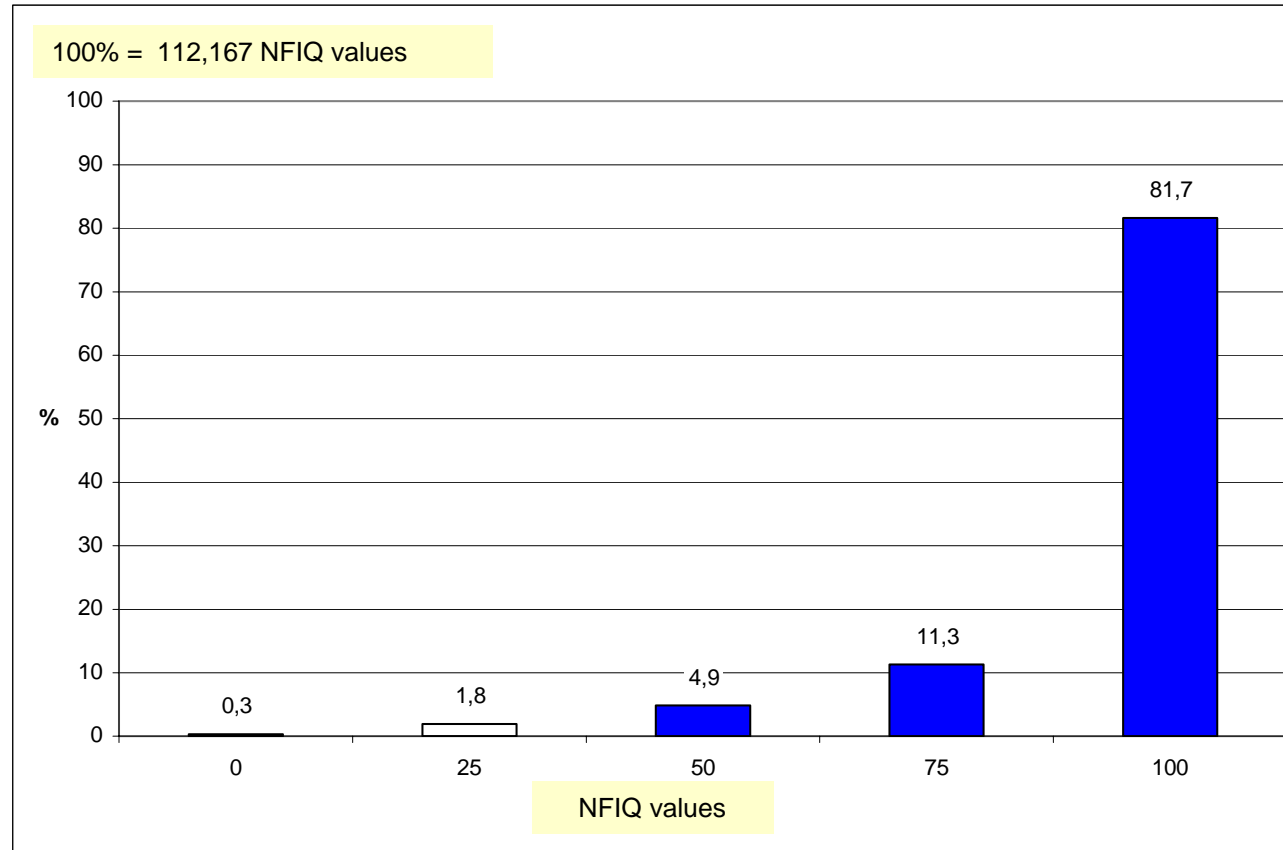
Successful concept of capturing 3 individual images



- In almost 50% out of 38,000 fingerprint images, the third image was selected, an obvious learning effect
- Conclusion: it is useful to choose from 3 individual images



Distribution of NFIQ quality scores



- More than 80% of 112,000 fingerprints had NFIQ=1, highest quality.
- Approx. 2% had NFIQ= 4 or NFIQ=5, lowest quality.

Conclusions

- Fingerprint enrolment creates so far **unknown challenges** for municipalities, citizens (...and the government).
- The German enrolment process is **quality centred** – only a few compromises for faster handling were accepted.
- Technically, a whole **new infrastructure** for the enrolment alone has to be installed/updated – not to mention the different PKI requirements
- **Pilot Testing** is of outmost importance, for enrolment issues and technical processes.
- **Education, training and up to date information** of municipalities and citizens has to be organized.
- A **conformity testing** scheme will be implemented to check all important components of the process.



Thank you for your attention...

Questions?

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