FACULTY OF SCIENCE

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A Security Review of the Biometric Passport

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Contents

I. Background

International developments

- After 9/11 international move towards stronger identification of citizens & travellers
- US: Visa waiver program after 25 Oct 06 only for countries with biometric passport
- Standards developed by ICAO: *International Civil Airline Organisation*
- EU regulations & timeframe

Role of the Netherlands

- Large trial “2B or not 2B” (6 cities, 15.000 participants, Sept’04-Feb’05), see later
- Philips main supplier of “smartMX” chips
- SDU Identification (inter)nationally active as document supplier
  (and also within ICAO and ISO).
- Issuance started 28 Aug’06, at first with facial scan only, without fingerprints
  (both passports and national identity cards)

Own involvement

- Membership of “expert council” set up by ministry of internal affairs
- Production of own terminal-side software
- Commercial consultancy/testing for ministry
- Role in discussion in media

Disclaimer: no biometry expert

Passport fraud

- Forgery of modern passports (NL, Ger, . . .) very difficult
- Production of passports is now centralised
- Criminal organisations collect lots of passports, and look for reasonable matches
- Passports also borrowed for illegal border crossing
- ***Look alike fraud*** is source of concern
- Hence original aim: biometric ***Verification***

Reasonable security goals

Passportchip with contactless access requires:

- Passport ***reader authenticates*** itself first and behaves “properly”

  Clarity about storage & use of biometric data
- ***No identifying information is released*** without the consent of the passport’s holder

  This should include identifi cation numbers of chips and country identifi cation: risk of bomb targeted at individuals/nationals.
- Receiver must be able to ***check authenticity and integrity*** of contained data

II. Standards & requirements

ICAO on MRTD

- MRTD: Machine Readable Travel Document
- Open standards, for states and suppliers
- PKI task force with members from US, UK, Can, Ger, NL.
- Only facial image mandatory; fingerprints, iris scan, etc. optional
- Only integrity check mandatory; several other protection mechanisms optional
- See **`http://www.icao.int/mrtd`**

EU on MRTD

- Facial scan included before 28 Aug ’06
- Fingerprints later, ≤ 3 year after agreement on protection mechanism
- ***Basic Access Control*** mandatory:
  - Access key for RFID chip extracted from ***Machine Readable Zone*** (MRZ)
  - Intended as consent to read

NL on MRTD

- Introduction in 2 stages, started 28 Aug ’06
- Also authenticity check required
- Original aim (2002): verification only, with decentralised storage of biometric data
- New aims (Jan. 2005, “letter on terror”):
  - identification, called “on line verification”
  - central database of biometric data
  - meant as contribution to effectivity of identification laws

Parliamentary approval still pending.

Outcome biometry trial in NL

- Report ***2B or not 2B*** appeared in Oct '06, online available, also in english:

`www.europeanbiometrics.info/images/resources/88_630_file.pdf`

- Focus on enrollment, not so much verification (only false negatives relevant)
- Real difficulties for ages <12 and >60
- Overal succesrate both fingerprints: $\sim$ 90% (faces not really tested; only 5 day interval)
- Useful experiment, with lots of practical experience (eg. exchange of fingers)

Protection mechanisms

	to protect	mechanism	EU	US
basic access ctrl	*access & confidentiality*	*encryption via key from MRZ*	+	+
passive authent.	*integrity of content*	*signature by SDU (by NL)*	+	+
active authent.	*authenticity of document*	*signing of challenge*	– NL+,Ger–	+
extended access ctrl	*confidentiality of fingerprints*	*BSI proposal*	+	n.a.

Metallic "Faraday cage" additional option.

International PKI

- ***Country Signing CA*** (NL) signs certificate of ***Document Signer*** (SDU)
- SDU signs "security object" in chip, for integrity (passive authentication)
- Passport chip contains:
  - SDU certificate
  - own public key (hash in security object)
- Self-signed country certificates distributed at first via diplomatic post, later electronically.

III. High level protocols

Basic Access Control I

- "Consent" & confidentiality mechanism
- MRZ info yields 3DES "document basic access keys" K_{ENC}, K_{MAC}, fixed for lifetime
- Relevant MRZ input:
  passport nr. + birth date + expiry date
- Entropy somewhere between 50 and 60 bits
- Brute force attack:
  - for skimming (neighboor in train) card too slow
  - possible on eavesdropped data
    (passport numbering system relevant)

Basic Access Control II

$$\textbf{Psp} \xrightarrow[\text{(8 byte)}]{N_P} \textbf{Rdr}$$

$$\textbf{Psp} \xleftarrow[K_{Enc}\{A\},K_{MAC}[K_{ENC}\{A\}]]{A:=N_P\|N_R\|K_R} \textbf{Rdr}$$

$$\textbf{Psp} \xrightarrow[K_{Enc}\{B\},K_{MAC}[K_{ENC}\{B\}]]{B:=N_P\|N_R\|K_P} \textbf{Rdr}$$

Session keys are then derived from K_P and K_R, for rest of communication.

Basic Access Control III

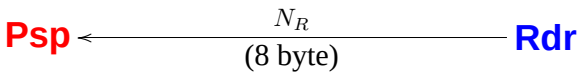
- July'05: Marc Witteman (Riscure) finds:
  - NL passportnrs. used in ascending order
  - About 5000 per day
  - Check digit formula uncovered
- January'06: eavesdropping shown on TV
- Substantial reduction of entropy (to ~ 35 bits)
- ICAO rejects strengthening of Basic Access Control (april'06)
- NL: issuance order becomes random
  (but eg. not in Germany)

Passive authentication: integrity

- Read "Security Object" from chip with:
  - SDU certificate (& public key for AA)
  - hashes of *all* passport data
  - SDU signature
- Authenticity check consists of:
  - check SDU-certificate with NL public key
  - check SDU-signature with SDU-certificate
  - check hashes, after reading data
- Cloning still possible: Grunwald at Black Hat (aug'06) for German passport (without AA)

Active authentication: authenticity

Passport has private (RSA) key, with public key in (signed) security document.



Risk of signing location + timing data in N_R, for tracking. Bas. Acc. Ctrl. offers some protection.

Extended access control

- For fingerprint protection; optional for ICAO
- Required by EU
- German (BSI) proposal:
  - Readers must authenticate, via certificates
  - New Diffie-Hellman session key for data protection
  - Certificate revocation is problematic
- Each country controls itself who can read fingerprints: limited use foreseen

IV. Passports for private use?

Secure logon via your passport

- Give your machine / local network:
  - your passport K_{MAC}, K_{ENC} (from MRZ)
  - your passport public key
- Authenticate yourself via challenge-response: “what you have”
- Strengthened “two factor” authentication possible with:
  - combination with traditional password
  - or picture check: “what you are”
- Will be implemented by RU

Digital signature via your passport?

Better not, because:

- Embedded private key used for challenge-response: incompatible with signing
- Anyone who accesses your passport can sign for you—e.g. at border crossing

V. Card & reader

Card info I

- SmartMX Chip from Philips (P5CT072), with:
  - 72Kbyte EEPROM
  - contactless interface (ISO/IEC 14443 A)
  - 3DES, RNG, RSA, SHA1 (ECC?)
- High certification: level EAL5+ of Common Criteria
- JavaCard OS: IBM JCOP41 version 2.20 Certification by German BSI ongoing
- Passport Java applet written by SDU: closed source

Card info II

- ***Writing*** to chip (e.g. for visa, children etc.) not foreseen.
- No certainty about absence of ***backdoors***.

  But secret access should be detectable via extensive monitoring

Contactless issues

- Operation distance < 10 cm; eavesdrop < 10m?
- Multiple cards may be in reach of reader
- ***Anti-collision*** protocol described in ISO 14443-3.
- NL: deployed card uses random identifier
- With fixed identifier “tree walking protocol”
  - 4 byte identifier
  - allows covert tracing and targeting

VI. Conclusions

Conclusions I

- Security goals reached?
  - Integrity & authenticity well-protected
  - Confidentiality weakest (~ 70 bit entropy, ideally)
  - No reader authentication (so far); no clarity about backoffice use of biometrics
  - NL implemented all available protection measures
- Choice for wireless connections hard to understand.

Conclusions II

- Biometric passports big social experiment:
  - Unwilling citizens may destroy chips
  - Action group may start campaign to do so
  - Such sabotage may destroy whole project
- Citizens have no control over what happens to their biometric data. Concerns:
  - Big brother / police state getting closer
  - Identity fraud
- On card reader & verification needed for trust

Conclusions III

- Biometry much overrated:
  - Silly: “same password, used everywhere”
  - Large scale use of biometrics uncertain
  - Many false positives/negatives expected
- Identification goals are undermined:
  - by widespread use in other applications
  - if many citizens (obnoxiously) put their fingerprints on the web
  - fingerprints are lost for high-level security by this setup: too many copies around

Conclusions IV

- *Will it stop terrorists?* ***No***, since they go for easy, soft targets
- *Will it reduce look-alike fraud?* ***Probably***, after a while
- *Will it reduce crime?* ***A bit***, mostly by catching/deterring stupid criminals
- *Will it introduce new risks?* ***Yes***, mostly for citizens: false negatives / identity fraud / function creep.

Further reading / info

- Juels (RSA labs), Molnar & Wagner (UC-Berkeley) at:

  `http://eprint.iacr.org/2005/095`
- Kc (U-Colombia) & Karger (IBM) at:

  `http://eprint.iacr.org/2005/404`
- Own passport paper (LNCS 4266) via:

  `http://www.cs.ru.nl/~jhh`
- Slides etc. via:

  `http://www.cs.ru.nl/B.Jacobs`