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 starts 28 Aug ’06, at first with facial scan only, without fingerprints

Own involvement

- Membership of “expert council” set up by ministry of internal affairs (Jacobs)
- Participation in enrollment procedure, resulting in test passport (Oostdijk)
- Production of own terminal-side software (Wichers Schreur) & test development
- Role in discussion in media

Disclaimer: no biometry experts

Passport fraud

- Forgery of modern (NL) passports very difficult
- Production of passports has been centralised
- Criminal organisations collect large numbers of passports, and look for reasonable matches
- ***Look alike fraud*** is source of concern
- Hence original aim: biometric ***Verification***

Reasonable security goals

Chip in passport with contactless access requires:

- ***No identifying information is released*** without the consent of the passport’s holder.
  This should include identification numbers of chips and country identification
  (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 (foreseen soon)
- ***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, starting 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

Outcome biometry trial in NL

- Report appeared in Oct '06, also in english (available online)
- 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*	+	+ (new)
passive authent.	*integrity of content*	*signature by SDU (by NL)*	+	+
active authent.	*authenticity of document*	*signing of challenge*	– NL +	+
extended access ctrl	*confidentiality of fingerprints*	*BSI proposal*	+	n.a.

Metallic "Faraday cage" possibly added (in US)

International PKI

- ***Country Signing CA*** (NL) signs certificate of ***Document Signer*** (SDU)
- SDU signs "security object", for 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

Basic Access Control II

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

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

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

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

Basic Access Control III

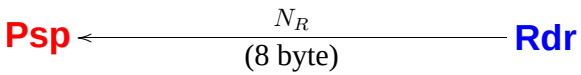
- July'06: Marc Witteman (Riscure) finds:
  - NL passportnrs. used in ascending order
  - About 5000 per day
  - Check digit formula discovered
- Substantial reduction of entropy (to ~ 35 bits)
- Ministry: issuance order deeply entrenched in procedures and checks
- ICAO is studying strengthening of Basic Access Control

Passive authentication

- Read "Security Object" from chip with:
  - SDU certificate
  - public key for active authentication
  - hashes of *all* passport data
  - SDU signature
- Authenticity check consists of:
  - SDU-certificate, using NL public key
  - signature by SDU, using SDU-certificate
  - hashes, after reading data
- Cloning still possible.

Active authentication, against cloning

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 authentication

- For fingerprint protection; optional for ICAO
- Required by EU, but no EU-standard yet
- German (BSI) proposal under consideration:
  - 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”
- Possibly add picture check: “what you are”.
- Will be implemented by RU

Digital signature via your passport?

Better not, because:

a. anyone who holds your passport can sign for you. [Sign software might check picture . . .]

b. sign-challenges only 64 bit (hash-attack: 32) Possible fix: break up sign-message

c. Proof of identity requires release of your MRZ (and hence access to your chip), since:

- MRZ contains your name + birth date
- hash of MRZ signed by authorities, as part of “security object”

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 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.
- With fixed identifier “tree walking protocol”
  - in current SDU test passport (4 byte id)
  - allows tracing and targeting
- SDU: “deployed card will use random identifier”

Reader implementation I

- Sample passport provided to RU, with ad hoc protection of fingerprints (via symmetric key)
- Own Java Terminal written – using BouncyCastle crypto library
  - Crypto ($\approx$ 2 KLOC)
  - Parsing ($\approx$ 2 KLOC)
  - GUI ($\approx$ 1.5 KLOC)
- Intention to release it as open source

Reader implementation II

- Many, many standards. ICAO public, but ISO not.
- Protocols often underspecified for abnormal situations
- Implementation not difficult, but many details
- Interoperability problems with contactless readers – may happen also in practice

VI. Conclusions

Conclusions I

- Biometric passports are on their way
- General approach (ICAO, EU): careful.
- Basic Access Control weak link.
- Protection of fingerprints not fully settled yet
- Open communication with Ministry & SDU
- Further tests of cards foreseen
  (also rôle of ***LaQuSo***)

Conclusions II

- Biometry much overrated:
  - Silly approach: “same password, used everywhere” (no template protection)
  - Large scale use of biometrics uncertain
  - Substantial false positives/negatives to be expected
- Identification goals are undermined:
  - by widespread use in other applications
  - if many citizens (obnoxiously) put their fingerprints on the web

Conclusions III

- Function creep risks:
  - Who will use passport’s biometrics?
    Welfare authorities, banks, casinos etc.?
  - Central storage: risks of compromise, misuse, etc.
- Set-up for improved identity management can lead to large scale identity theft.
- Real challenges (also for privacy!) are in the in integration in backoffice databases
- Slow increase of use to be expected

Conclusions IV

- Passport fraude will become more difficult
- But the few (if any) who manage to break the system get unprecedented power
  (issue their own passports . . .)
- Will it stop terrorists? ***No***, since they go for easy, soft targets
- Will it work? ***Probably***, after a while
- Will it help? ***A bit***, mostly to deter/catch stupid criminals

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`

- Slides etc. via:

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

Thanks for your attention!