E-Passport Validation – A practical experience

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Current State of Play

- More than 135 countries issuing E-Passports
- High Value Target Countries issuing only E-Passports

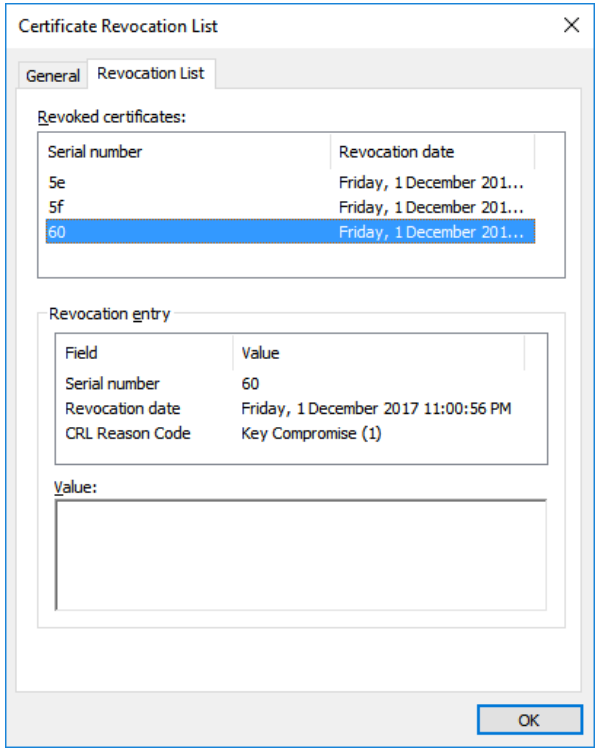
- Many Borders attempting validation of E-Passports
- Challenges remain

Challenge 1 – Availability of CSCAs

- CSCA exchange expected to occur bilaterally.
- MasterLists are secondary source of CSCAs
  - CSCAs from 86 countries currently available from Masterlists – far short of the 135+ countries issuing ePassports
  - May still be missing some CSCAs from these countries

Challenge 2 – Availability of CRLs

- ICAO PKD primary source of CRLs
- Secondary source: Publishing of CRL on website or publicly available LDAP
- PKD has CRLs from 37 countries
- From CRL DP, can obtain about 62 CRLs

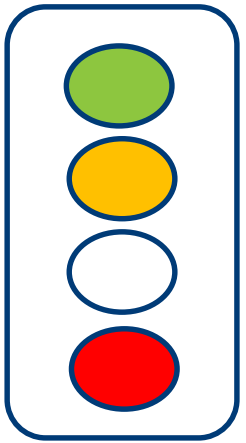


Challenge 3 – Processing Time

- Passenger processing time should be as short as possible – usual target is under 10 seconds
- Depends on:
  - Architecture – validation done in:
    - Reader – Fastest response. Updates are a nightmare
    - Inspection Terminal – Almost as fast as Reader. Easier updates
    - Centralized Service – Easy to update. Network latency can be an issue
  - Crypto Toolkit – Brainpool curves take longer to verify – All countries implementing ECDSA are using brainpool curves

Challenge 4 – Visualization of Results

- Too much information being given to officer who then needs to make a judgement call.
- Map the information to the expected outcome decisions
  - New scenarios can also be mapped, so officer training is simplified

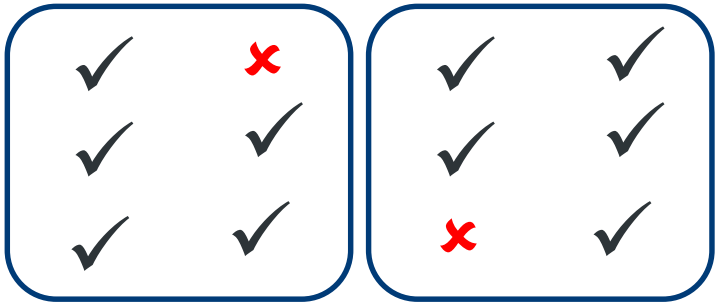


Challenge 5 – Defective documents

- Have identified 23 defects across 55 countries – will result in False Negative on these documents i.e. perfectly good documents being flagged as fraudulent.
- Based on our discussions with multiple border control agencies, numbers between 11% to 46% of all validations
  - Depends on the traveler profile and toolkit (not all toolkits give the same result)

Challenge 5 – Defective documents
Mitigation Strategy 1

- In case of failure, human fallback
- Most common mechanism in ABCs where a single officer is looking at screens from 4-6 ABCs and has to take a go/no go decision



Desensitizes officer to possible frauds – Fatigue leads to error

Challenge 5 – Defective documents
Mitigation Strategy 2

- Profile the document - Deviation List/Defect list approach

A typical workflow:

1. ePassport fails signature verification
2. Check if the country is in a list of known defective documents
3. Check if it passes Active Authentication/Chip Authentication
4. Check that the DG14/DG15 hash matches the hash in SOD. If so, declare ePassport to be good passport

Challenge 5 – Defective documents
Mitigation Strategy 2

- A known attack on this strategy

What is known:

1. ePassport from this target country fails verification due to a small defect in the Document Signer.
2. Country does support Active Authentication
3. Fraudulent document with chip contains proper LDS including DG15 and implements Active Authentication using this public key
4. The SOD contains the correct hash of DG15, but the Signerinfos is copied from a proper SOD.
5. Signature verification fails – No means to differentiate between actual signature verification failure (real failure) and failure due to Doc Signer defect. Hence previous method of profiling returns the document as a valid document

Challenge 5 – Defective documents
Mitigation Strategy 3

- Defect Handling - Modify Crypto Toolkit to verify in spite of Defect

- Requires detailed analysis of defect
- Modify Crypto Toolkit to verify in spite of the defect
- Ensure that Security is not compromised as a result of this modification

Challenge 5 – Defective documents
Mitigation Strategy 3

- Defect Handling – An example

- RSA signature is result of modular(division) operation
- Since it is division, value will be smaller than the divisor
- RFC requires that if length of remainder is smaller than the divisor, then zeroes to be padded in front to make it the same length

Let the divisor be
“3B 9A CD F3”
If remainder is
“80 4B 82”
Then result is encoded as
“00 80 4B 82”

Challenge 5 – Defective documents
Mitigation Strategy 3

- Defect Handling – An example (cont'd)

- Verification of RSA signature requires the following steps:
  - If length of signature longer than divisor, verification failure
  - If length equal to divisor, remove leading zeroes
  - Continue with computation

- Remainder is "00 80 4B 82"
- Divisor is "3B 9A CD F3"
- Length is same
- Remove leading zeroes to get value "80 4B 82"
- Continue with the computation

Challenge 5 – Defective documents
Mitigation Strategy 3

- Defect Handling – An example (cont'd)

- The actual defect is ePassports issued by two countries is the addition of an extra leading zero
- Hence the length of the remainder is longer than the divisor and signature verification fails

Divisor is
"3B 9A CD F3"
Remainder is
"3A 04 4B 82"
Result is encoded as
"00 3A 04 4B 82"

Challenge 5 – Defective documents
Mitigation Strategy 3

- Defect Handling – An example (cont'd)

The solution to handle this defect:

- Remove the leading zeroes first
- Then compare value
- Continue with computation

Result is encoded as
"00 3A 04 4B 82"
Remove leading zeroes gives
"3A 04 4B 82"
Value smaller than divisor
"3B 9A CD F3"
Continue with computation

Challenge 5 – Defective documents
Mitigation Strategy 3

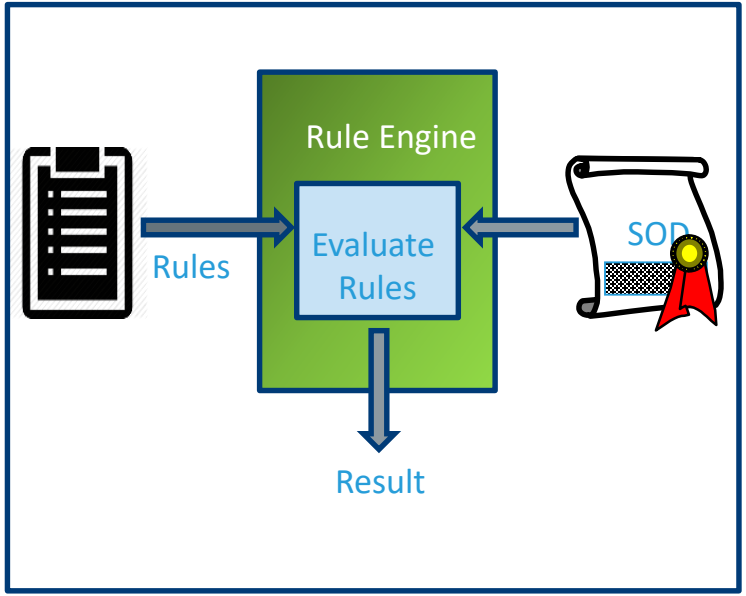
- Defect Handling – Does it work for all defects?

- Based on our analysis, all known defects can be handled
- We chose not to handle one defect of missing AKI
  - An AKI is the field in Document Signer that links the Document Signer to the CSCA.
  - Missing in the case of Venezuela and Somalia
- An older defect of truncated SOD also cannot be handled

Challenge 6 – Defining the anatomy of a fraud

- If hash comparison of DG2 fails, it is indication of substitution attack on the photo in the chip and should be considered a fraudulent document
- If hash comparison of DG11 fails, is that as serious as a DG2 hash mismatch?

Every failure is not a fraud



ICBWG

- Has a non compliance sub group that analyzes defects and informs countries through ICAO state letters – rectify defect at source
- How to get in touch:

Step 1 Send an email to the icbwg@icao.int along with a brief description of the concern and an image of the data page. For issues related to ePassports, include the SOD.

Step 2 ICBWG will assess the reported issue and supporting information in context of the Doc 9303 standards.

Step 3 Once confirmed, the ICBWG will contact the issuing State to lend assistance. The originator will also be advised of the outcome.

Summary

- If you are not doing ePassport validation at border, all the investment in ePassports is a waste
- Do it right or trust in the document will be lost
- Engage with ICAO working groups to get it right

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