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Travel Document Integrity and Border Control

Dr. Uwe Seidel

Head of Department IT Forensics & Documents,
German Federal Criminal Police Office
Chairperson, New Technologies Working Group
(NTWG) of TAG/TRIP

We start our journey here...

Vollrads Castle (≈1330) in the Rheingau region of Germany



Document security dimensions

Passport 1796

- **Document Security**

Security printing, exclusive material

→ **Physical Security Features**

- **Binding it to the holder**

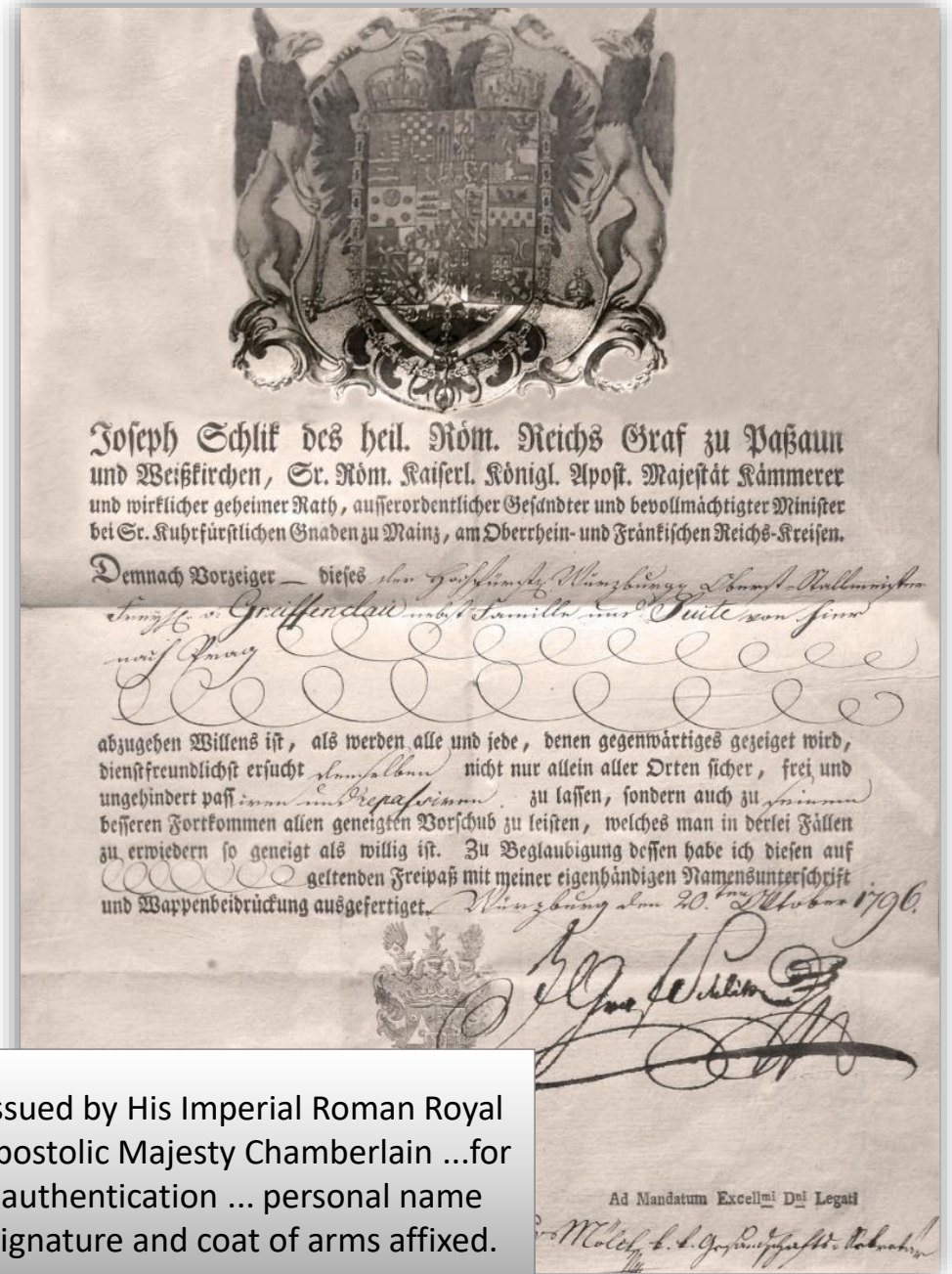
„...v. Greiffenclau nebst Familie und Suite...“

→ **Biometrics**

- **Integrity and Authenticity**

„Sr. Röm. Kaiserl. Königl. Apostol. Majestät Kämmerer ...zur Beglaubigung ... eigenhändigen Namensunterschrift und Wappenbeidrückung ausgefertigt.“

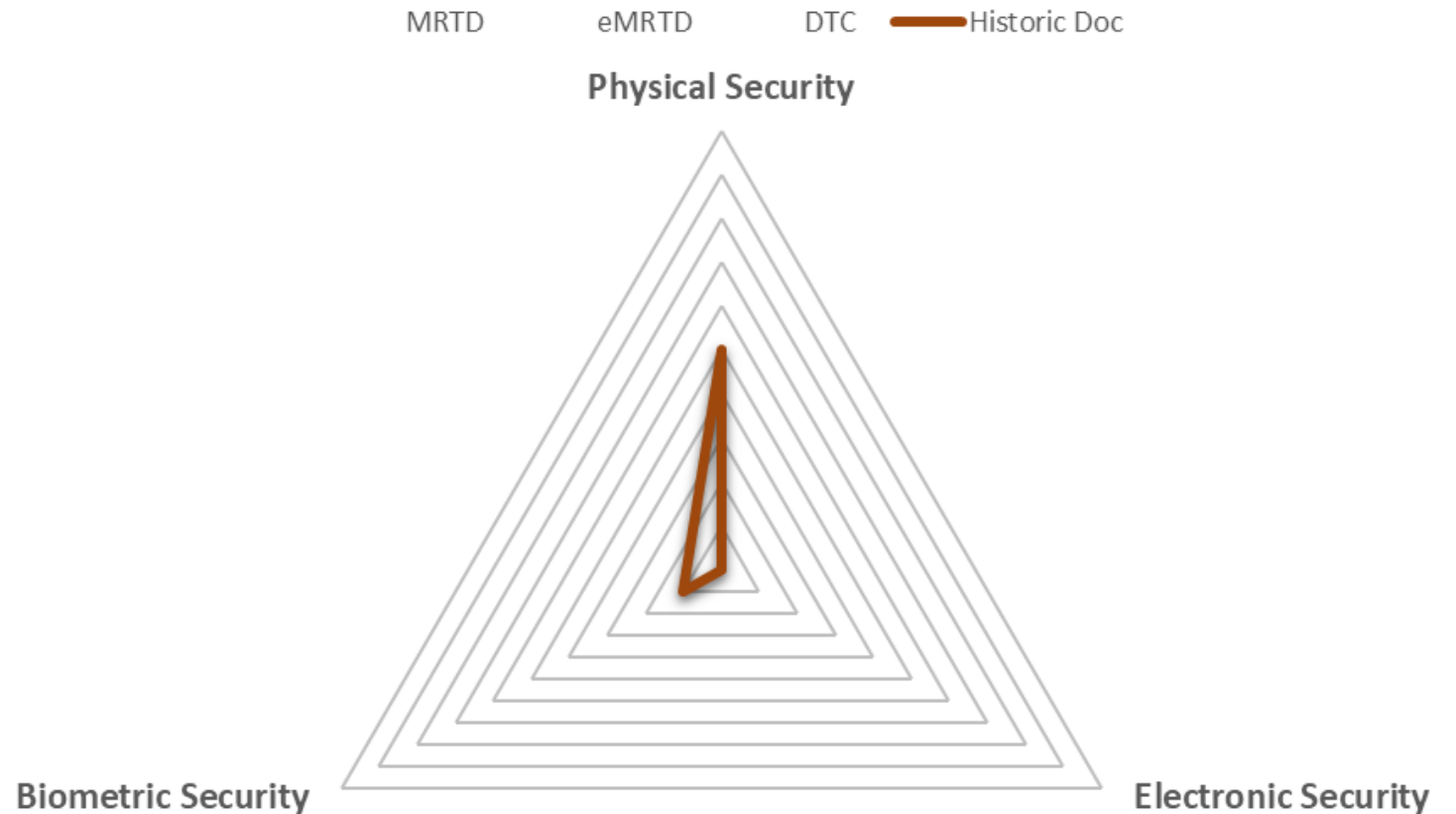
→ **Electronic Documents**



Issued by His Imperial Roman Royal Apostolic Majesty Chamberlain ...for authentication ... personal name signature and coat of arms affixed.

Document security dimensions – historic travel document

- Some physical document security
- Very little „biometrics“ (description of the holder)
- No electronics 🤖



ICAO Machine Readable Travel Document (MRTD)

MRTD security (e.g. German passport)

Substrate materials

- UV dull substrate, watermarks, sensitizers, fibers, threads ...

Security design and printing

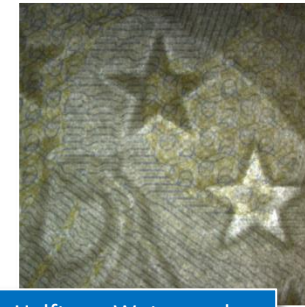
- Guilloche/rainbow printing, microprint, special inks, numbering ...

Protection against copying and alteration

- Optically variable devices, multiple laser images, ...

Personalization techniques

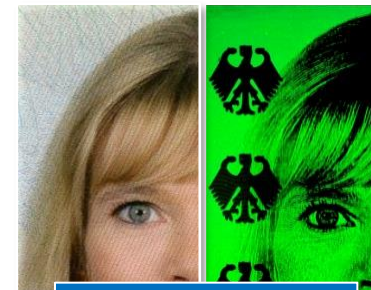
- Integration of personal data in the basis material of the document, e.g. by laser engraving



Halftone Watermark



Security Printing (UV)



Individual hologram



3D-Eagle above window



Tactile laser engraving



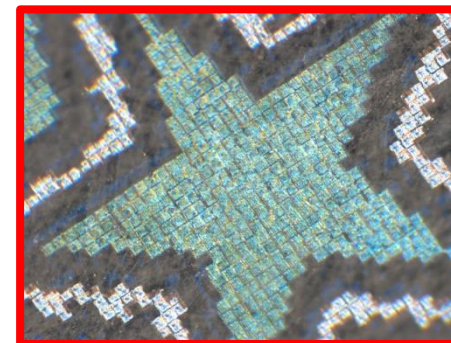
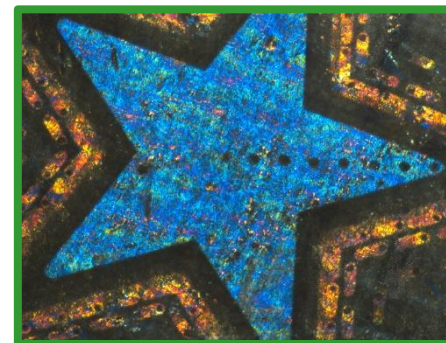
Multiple laser image

ICAO Machine Readable Travel Document (MRTD)

Challenges: Crime as a service

Increasing counterfeit pressure

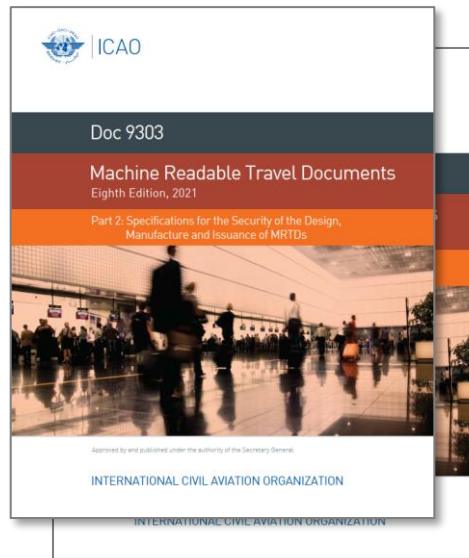
- Document fraud today is highly diverse: printing, personalization and security features are provided by specialized entities.
- The darknet, but also the open web provides numerous opportunities to purchase counterfeit documents and components.
- Alterations become more subtle: only small parts of the data, e.g. the portrait, are overprinted to show a (slightly) different person.



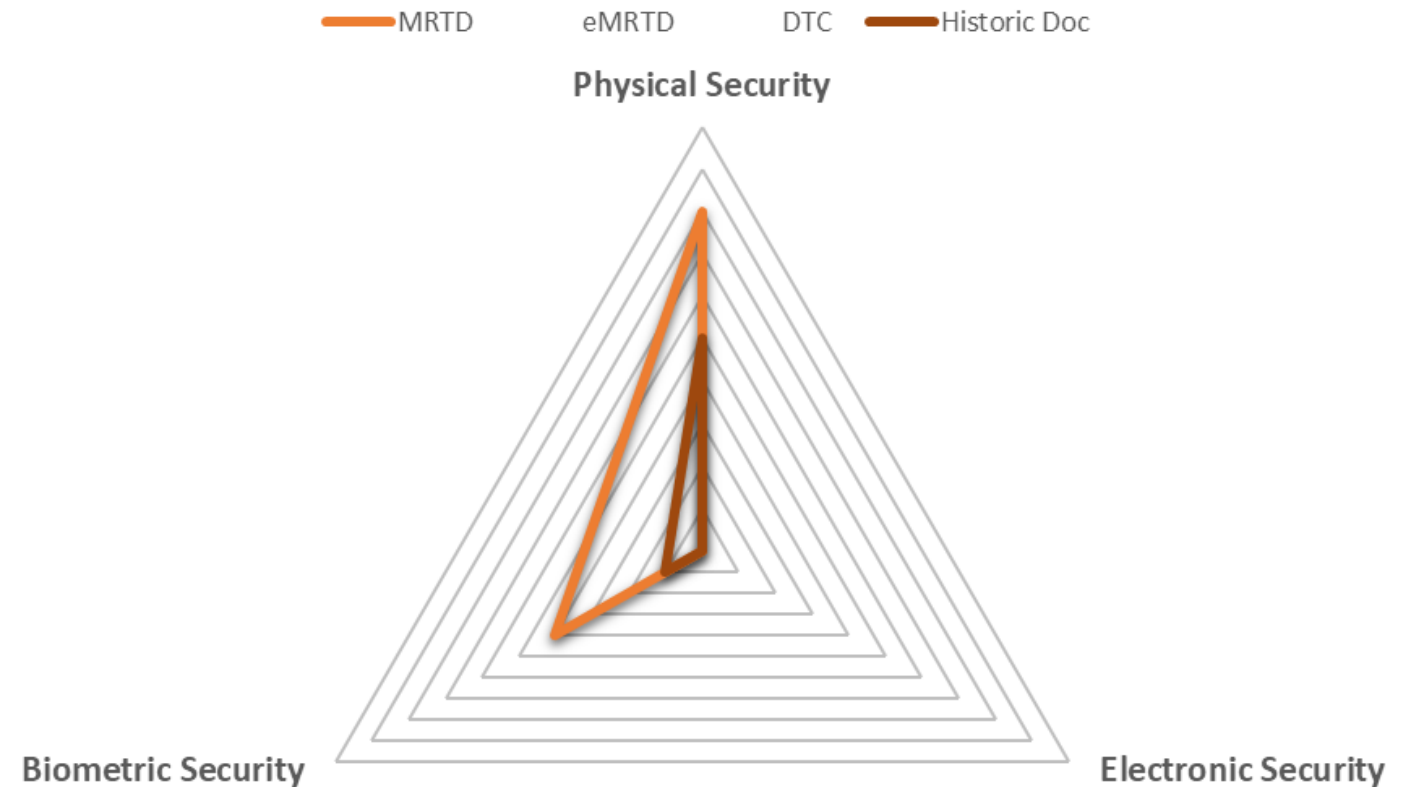
DOVID EU Residence Permit

Document security dimensions – ICAO MRTD

- Complex physical document security
- Printed portrait (biometrics)
- No electronic features (yet)



ICAO Doc 9303 Parts 2, 3, 4, ...



ICAO eMRTD = Physical MRTD + Chip (data structure with biometrics)



LDS

		DATA ELEMENTS
REQUIRED	ISSUING STATE OR ORGANIZATION DATA	Document Type
		Issuing State or organization
		Name (of Holder)
		Document Number
		Check Digit - Doc Number
		Nationality
		Date of Birth
		Check Digit - DOB
		Sex
		Date of Expiry or Valid Until Date
		Check Digit DOE/VUD
		Optional Data
		Check Digit - Optional Data Field
		Composite Check Digit
OPTIONAL	ISSUING STATE OR ORGANIZATION DATA	Encoded Identification Feature(s)
		Global Interchange Feature
		Additional Feature(s)
		Encoded Face
		Encoded Finger(s)
		Encoded Eye(s)
		Displayed Portrait
		Reserved for Future Use
		Displayed Signature or Usual Mark
		Data Feature(s)
		Structure Feature(s)
		Substance Feature(s)
		Additional Personal Detail(s)
		Additional Document Detail(s)
		Optional Detail(s)
		Security Options
		Active Authentication Public Key Info
		Person(s) to Notify

DataGroup 1



- Document Type
- Issuing State
- Name of Holder
- Document Number
- Nationality
- Date of Birth
- Check Digit DOB
- Sex
- Date of Expiry
- ...

DataGroup 2



DataGroup 3



EU mandatory

- 2 Fingerprints



ICAO Electronic Machine Readable Travel Document (eMRTD)

Challenges: High tech crime using the technology almost perfectly

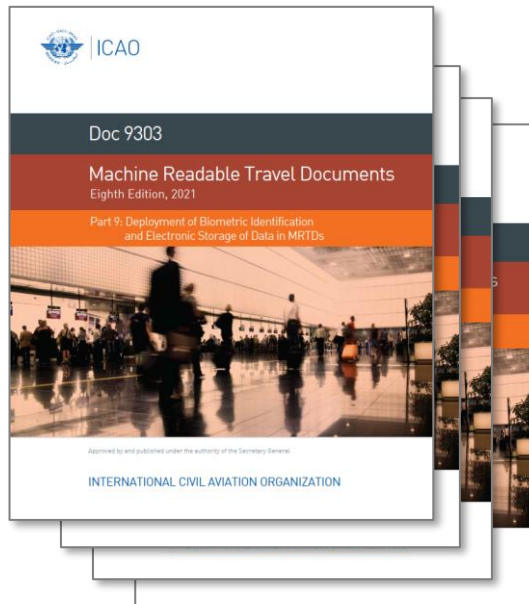
The story of the UK e-passport 2008

- 3.000 blank passports were stolen from a transport van in the UK
- Press release: „highly complex task to personalize the documents“
- A few month later, this passport was stopped in Frankfurt airport after having travelled half the world
- The original (blank) chip was destroyed, a new chip added containing data matching the (fraudulent) personalization.
- **What gave it away: the missing digital signature of the UK (and the SLTD entry)**

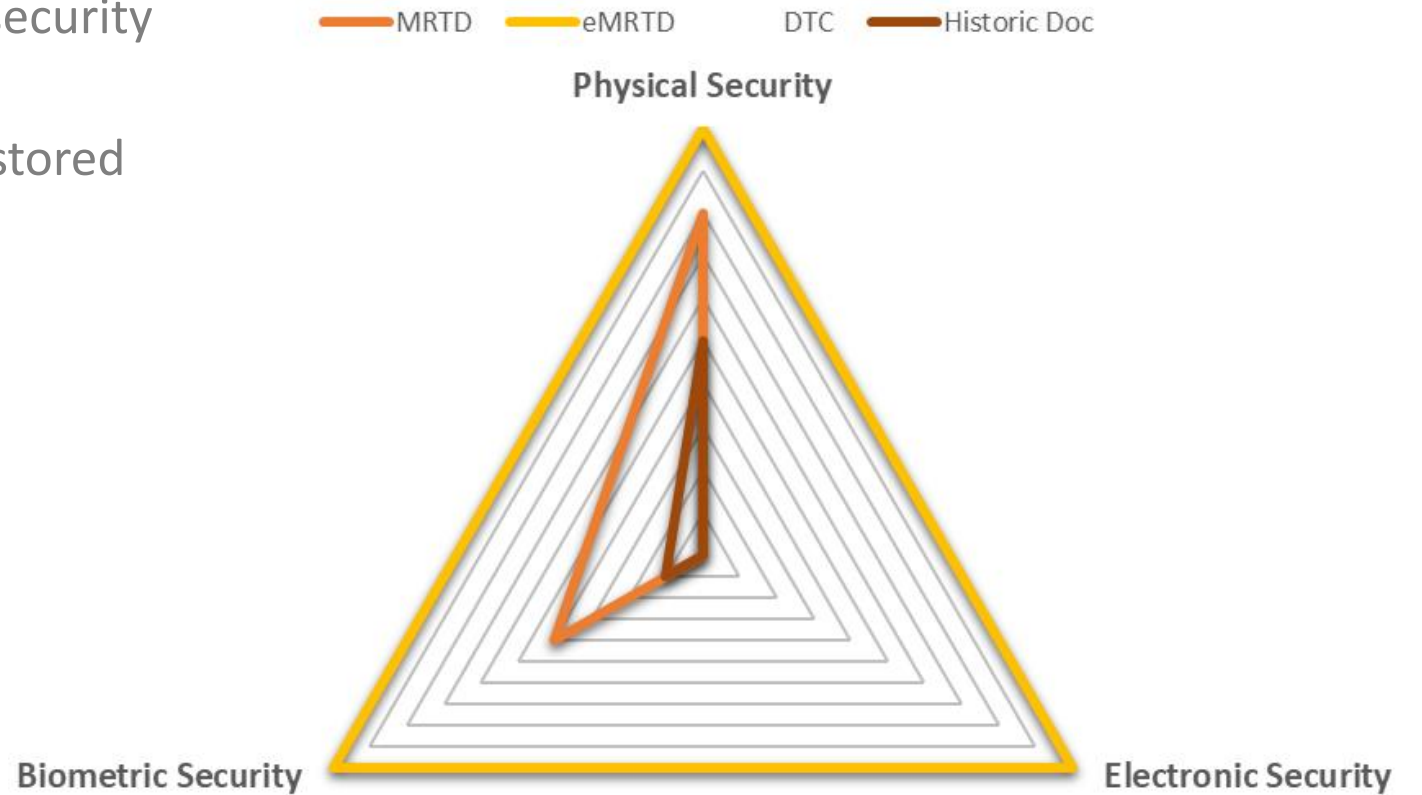


Document security dimensions – ICAO eMRTD

- Complex physical document security + chip features
- Printed portrait and digitally stored biometrics
- Complex electronic features



ICAO Doc 9303 Parts 9-12



Digital Travel Credentials (DTC)



LDS

		DATA ELEMENTS
REQUIRED	ISSUING STATE OR ORGANIZATION DATA	Document Type
		Issuing State or organization
		Name (of Holder)
		Document Number
		Check Digit - Doc Number
		Nationality
		Date of Birth
		Check Digit - DOB
		Sex
		Date of Expiry or Valid Until Date
		Check Digit DOE/VUD
		Optional Data
		Check Digit - Optional Data Field
		Composite Check Digit
		Encoded Identification Feature(s)
OPTIONAL	ISSUING STATE OR ORGANIZATION DATA	Global Interchange Feature
		Additional Feature(s)
		Encoded Face
		Encoded Finger(s)
		Encoded Eye(s)
		Displayed Portrait
		Reserved for Future Use
		Displayed Signature or Usual Mark
		Data Feature(s)
		Structure Feature(s)
		Substance Feature(s)
		Additional Personal Detail(s)
		Additional Document Detail(s)
		Optional Detail(s)
		Security Options
		Active Authentication Public Key Info
		Person(s) to Notify

DataGroup 1

- Document Type
- Issuing State
- Name of Holder
- Document Number
- Nationality
- Date of Birth
- Check Digit DOB
- Sex
- Date of Expiry
- ...

DataGroup 2



To proof integrity and authenticity of the data, the chip contains the Document Security Object

EF.SOD

Hash (DataGroup 1)

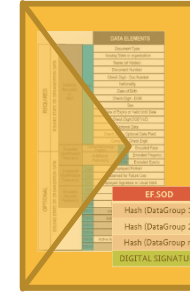
Hash (DataGroup 2)

Hash (DataGroup n)

DIGITAL SIGNATURE

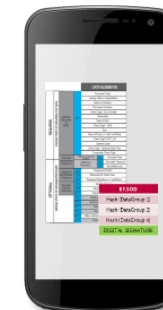
Digital Travel Credential (DTC)

The Hybrid concept



Hybrid Concept: A DTC consists of a **Virtual Component (DTC-VC)** containing the digital representation of the holder's identity and one **Physical Component (DTC-PC)** that is cryptographically linked to the Virtual Component.

1. **eMRTD bound:** DTC-VC with the eMRTD as the (only) DTC-PC. Chipdata is read from existing travel document creating the VC.
2. **eMRTD-PC bound:** The physical device will serve as the DTC-PC, with the eMRTD as the alternate or as a fallback DTC-PC. Chipdata is read from existing travel document creating the VC, option to cryptographically link to a different PC.
3. **PC-bound:** DTC-VC and DTC-PC but NO eMRTD as fallback anymore. Only the physical device will serve as the PC.



ICAO compliant eMRTD and DTC

Challenge: certificate distribution for secure authentication

More than 150 countries issuing E-Passports

To validate an ePassport, you need the Root of Trust of that country (CSCA certs), CSCA exchanges are expected to occur bilaterally

Master Lists are secondary source of CSCAs:

- ICAO Masterlist contains CSCAs from 66 issuers; all Masterlists combined contain CSCAs from 104 issuer
→ Still short of 150 countries!

Certificate Revocation Lists (CRL):

- ICAO PKD has CRLs from 47 countries; from CRL distribution point (DP), one can obtain another 16 CRLs
→ Still short of 150 countries!

ICAO compliant eMRTD & DTC

Challenge: Morphing of passport images

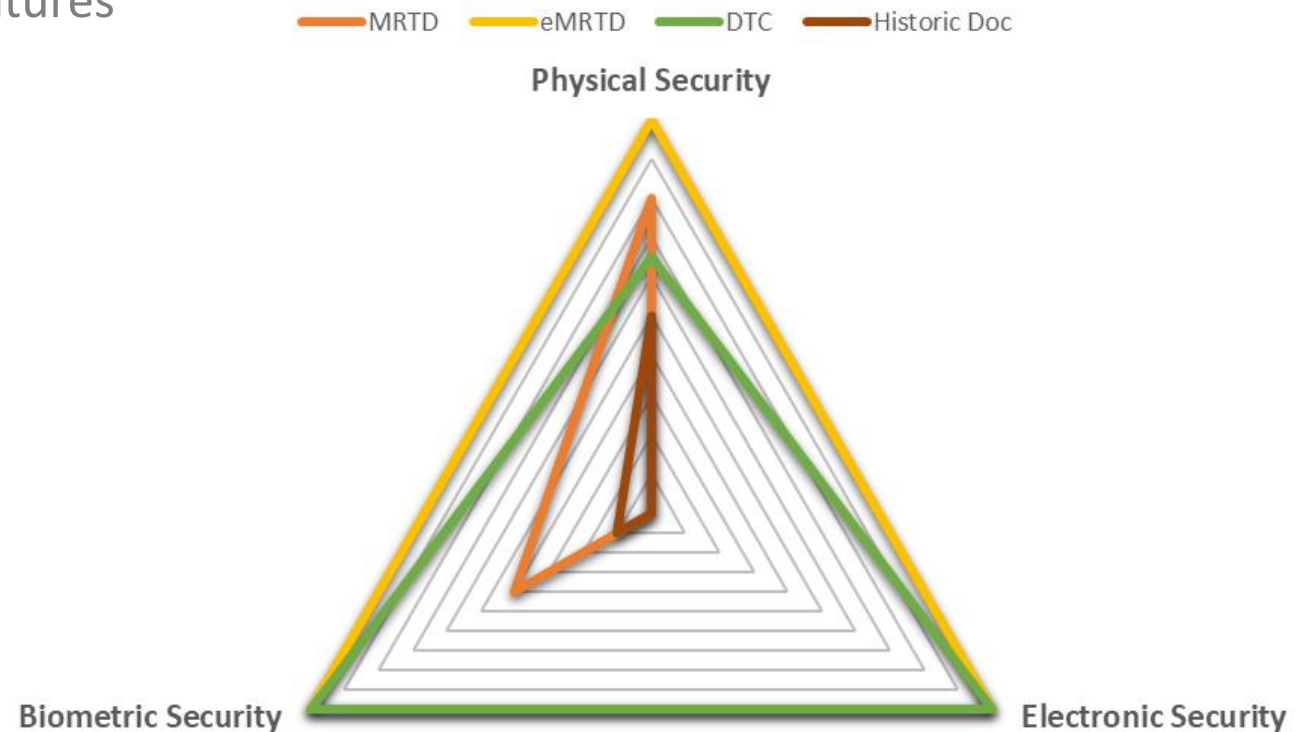
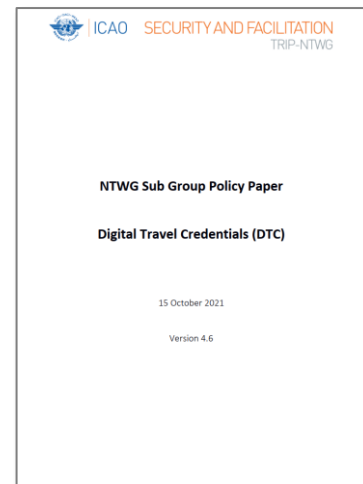
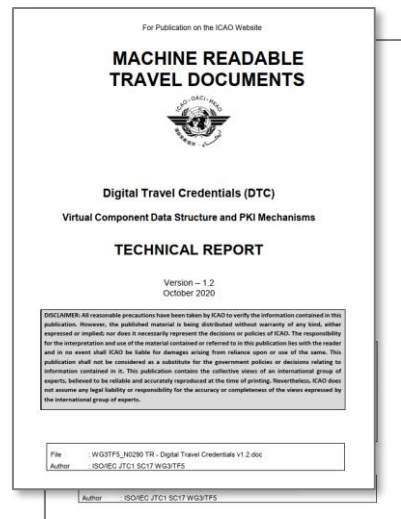
- Morphing combines two images into one resembling the facial features of two individuals: both visually and for facial recognition algorithms
- On Sept. 22, 2018, a group of activists announced that they put a morph image – also containing Federica Mogherini (the EU Foreign Ambassador) – into a German passport application to protest the use of passports to control asylum seekers
- Anti-morphing measures:
 - a) domestic: invest in live-enrolment
 - b) border: invest in research for detection technologies



SPIEGEL ONLINE

Document security dimensions – Digital Travel Credential (DTC)

- No physical document security features
- Digitally stored biometrics
- Complex electronic features
- Link to chip hardware when using authentication (AA, CA) protocols



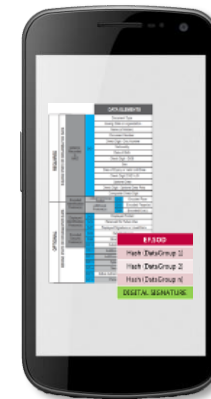
ICAO Technical Reports and Policy Paper

Summary

- MRTDs and eMRTDs are under **constant counterfeiting pressure** – high-tech crime-as-a-service fuels this trend, despite of technological advances of the issuer.
- **Electronic MRTDs and Digital Travel Credentials** are developing, its security depending on electronic authentication and biometrics (especially for DTCs).
- **Facial image biometrics' use is growing**, by the use of e-passports, digitized identities and in large databases.

Therefore, key elements for secure travel documents are:

- ICAO compliant deployment of security mechanisms, including 100% global certificate exchange and its use
- Secure and reliable enrolment of biometrics



Thank You

