ISO/IEC 39794-x Adoption in ICAO 9303

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Version 1

Who am I?

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- Member of the ISO/IEC SC37 Biometrics
- Board member of the European Association for Biometrics

Before we start…

This presentation is given as expert of the standardization committee ISO/IEC SC37 working group 3, National Body Germany.

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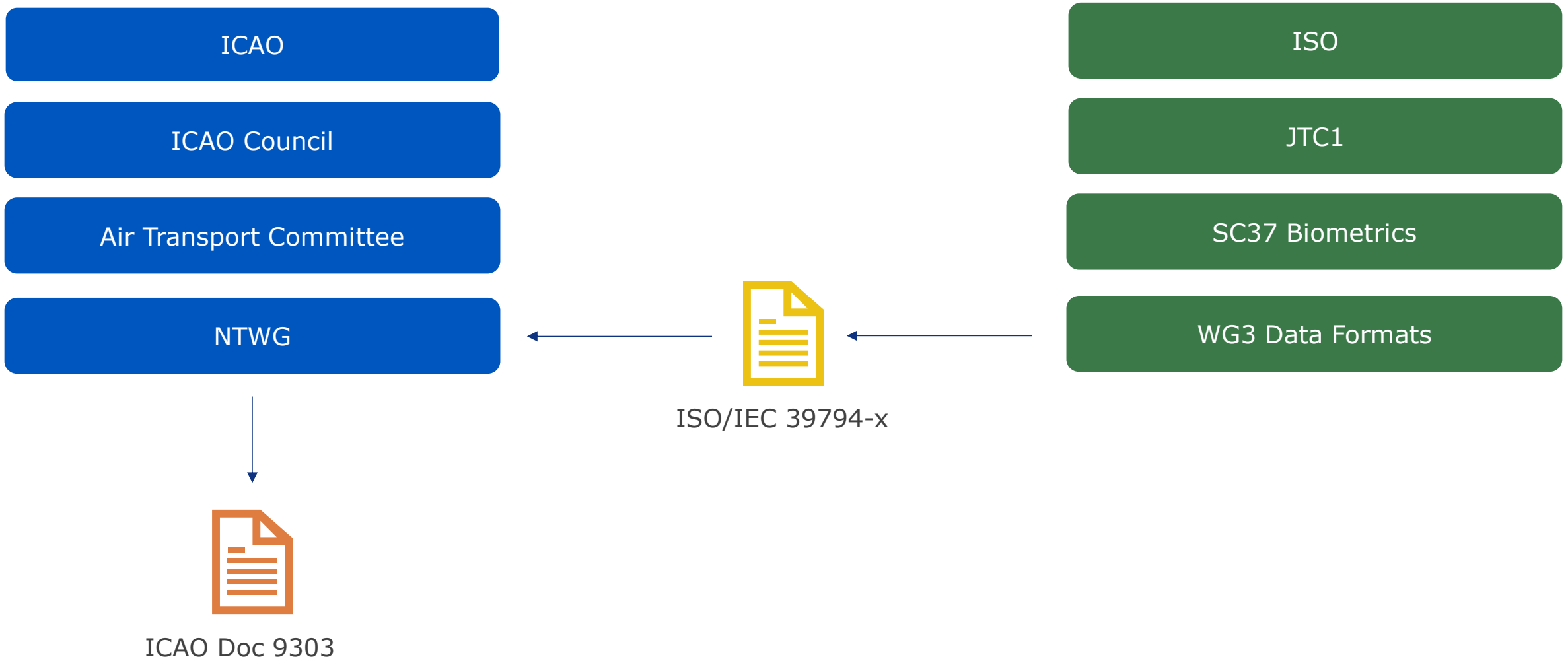
ICAO and ISO


ICAO
ICAO Council
Air Transport Committee
NTWG
ISO
JTC1
SC37 Biometrics
WG3 Data Formats
ISO/IEC 39794-x
ICAO Doc 9303

A little bit of history…

- First generation was a hand-picked Type-Length-Value format
- With the growing importance of web-based application the need for a nonbinary format arises
- Second generation was convertible to first generation, but not compatible
- Third generation solved the problem of compatibility and extensibility to be future proof
- ISO/IEC 39794-x was developed with input of all stake holders
- After publication of ISO/IEC 39794-4 the ICAO NTWG developed a profile for replacing ISO/IEC 19794 with ISO/IEC 39794
- The adoption process is currently running

Comparison 19794 vs 39794

ISO/IEC 19794

- Format
  - Hand selected TLV (1st Generation)
  - XML based (2nd Generation)
- Format conversion
  - 1st generation can be converted to 2nd generation, but conversion needs to be done manual
- Implementation support
  - 1st generation
    - Hand selected TLV requires manual implementation
  - 2nd generation
    - Schema based, implementation can be generated by schema compilers
- Future Extensions
  - Any future extension to the standard will require a full standard review process

ISO/IEC 39794

- Format
  - ASN.1 and XML, equivalent module and schema definition
- Format conversion
  - Due to the equivalent module and schema definition, the conversion rules are well defined
  - Conversion can be automated
- Implementation support
  - Module definition and XML schema can be used to generate automatically the implementation
- Future Extensions
  - Extensibility is designed-in
  - Extensions can be standardized outside the base standard (Example: ISO/IEC 39794-12 is about to extend ISO/IEC 39794-4)

Extensions to ISO/IEC 39794

Extensions in ASN.1

- Achieved by using the ellipsis marker '…'

```
FingerImageDataBlock ::= [APPLICATION 4] SEQUENCE {
  versionBlock [0] VersionBlock,
  representationBlocks [1] RepresentationBlocks,
  ...
}
```

Extensions in XML

- Achieved by using the <any/> element

```
<xs:complexType name="FingerImageDataBlockType">
  <xs:sequence>
    <xs:element name="versionBlock"
                type="cmn:VersionBlockType" />
    <xs:element name="representationBlocks"
                type="RepresentationBlocksType" />
    <xs:any minOccurs="0"
            namespace="##other"
            processContents="lax" />
  </xs:sequence>
</xs:complexType>
```

- The extension is always optional
- There are no further requirements on the extensions

Special handling for enumerations

The enumeration problem

- Enumerations are predefined integers, but
  - The enumeration may have gaps
  - Values can be defined implicit or explicit

C/C++ enumeration

- Implicit

```
enum season {
  spring,
  summer,
  autumn,
  winter
};
```

- Explicit

```
enum season {
  spring = 0,
  summer = 4,
  autumn = 8,
  winter = 12
};
```

Java enumeration

- Implicit

```
enum season {
  spring,
  summer,
  autumn,
  winter
};
```

- Explicit

```
enum season {
  spring(0),
  summer(4),
  autumn(8),
  winter(12);

  private int _value;
  private season( int v ) {
    _value = v;
  }
};
```

XML enumeration

- Implicit

```
<xs:simpleType name="season">
  <xs:restriction base="xs:string">
    <xs:enumeration value="spring"/>
    <xs:enumeration value="summer"/>
    <xs:enumeration value="autumn"/>
    <xs:enumeration value="winter"/>
  </xs:restriction>
</xs:simpleType>
```

- Explicit
  - No supported

ASN.1 enumeration

- Implicit
  - Not supported
- Explicit

```
season ::= ENUMERATED {
  spring (0),
  summer (4),
  autumn (8),
  winter (12)
}
```

Enumerations in ISO/IEC 39794

XML enumerations

- Redefining enumeration for XML to support explicit definitions

```
<xs:complexType name="season">
  <xs:choice>
    <xs:element name="spring" type="xs:int" fixed="0"/>
    <xs:element name="summer" type="xs:int" fixed="4"/>
    <xs:element name="autumn" type="xs:int" fixed="8"/>
    <xs:element name="winter" type="xs:int" fixed="12"/>
  </xs:choice>
</xs:complexType>
```

- Valid notation when being used

```
...
<spring/>
...
<spring>0</spring>
...
```

- Invalid notation when being used

```
...
<summer>69</summer>
...
```

ASN.1 enumerations

- No change for ASN.1 required

```
season ::= ENUMERATED {
  spring (0),
  summer (4),
  autumn (8),
  winter (12)
}
```

Extensible enumerations in ISO/IEC 39794

- Extensible enumerations require a fallback mechanism

XML enumerations

- Redefining enumeration for XML to support explicit definitions

```
<xs:complexType name="seasonCodeType">
  <xs:choice>
    <xs:element name="spring" type="xs:int" fixed="0"/>
    <xs:element name="summer" type="xs:int" fixed="4"/>
    <xs:element name="autumn" type="xs:int" fixed="8"/>
    <xs:element name="winter" type="xs:int" fixed="12"/>
  </xs:choice>
</xs:complexType>

<xs:complexType name="seasonExtensionBlockType">
  <xs:sequence>
    <xs:element name="fallback" type="seasonCodeType"/>
    <xs:any namespace="##other" processContents="lax"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="season">
  <xs:choice>
    <xs:element name="code" type="seasonCodeType"/>
    <xs:element name="extensionBlock"
                type="seasonExtensionBlockType"/>
  </xs:choice>
</xs:complexType>
```

ASN.1 enumerations

- No change for ASN.1 required

```
seasonCode ::= ENUMERATED {
  spring (0),
  summer (4),
  autumn (8),
  winter (12)
}

seasonExtensionBlock ::= SEQUENCE {
  fallback [0] seasonCode,
  ...
}

season ::= CHOICE {
  code [0] seasonCode,
  extensionBlock [1] seasonExtensionBlock
}
```

Profiling of ISO/IEC 39794 for Doc 9303

- During adaption of the ISO/IEC 39794 by ICAO a joint working group discussed
  - The complexity of reading an ISO/IEC 39794 data package
  - Simplified error handling to ensure robustness during the eMRTD processing
- Work activities recorded in
  - ISO/IEC 49794
  - IACO TR “ISO/IEC 39794-5 Application Profile for eMRTDs”
- ISO/IEC 39794 was adopted with a slight profiling for the use of enumerations
  - Simplified reading and error handling

Extensible enumerations in Doc 9303

- **Will always require the ExtensionBlock! But still conformant with ISO/IEC 39794**

XML enumerations

- Redefining enumeration for XML to support explicit definitions

```
<xs:complexType name="seasonCodeType">
  <xs:choice>
    <xs:element name="spring" type="xs:int" fixed="0"/>
    <xs:element name="summer" type="xs:int" fixed="4"/>
    <xs:element name="autumn" type="xs:int" fixed="8"/>
    <xs:element name="winter" type="xs:int" fixed="12"/>
  </xs:choice>
</xs:complexType>

<xs:complexType name="seasonExtensionBlockType">
  <xs:sequence>
    <xs:element name="fallback" type="seasonCodeType"/>
    <xs:any namespace="##other" processContents="lax"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="season">
  <xs:choice>
    <xs:element name="code" type="seasonCodeType"/>
    <xs:element name="extensionBlock"
                type="seasonExtensionBlockType"/>
  </xs:choice>
</xs:complexType>
```

ASN.1 enumerations

- No change for ASN.1 required

```
seasonCode ::= ENUMERATED {
  spring (0),
  summer (4),
  autumn (8),
  winter (12)
}

seasonExtensionBlock ::= SEQUENCE {
  fallback [0] seasonCode,
  ...
}

season ::= CHOICE {
  code [0] seasonCode,
  extensionBlock [1] seasonExtensionBlock
}
```

ISO/IEC 19794 embedding ISO/IEC in Doc 9303

<table>
<tr><td>Tag</td><td>Length</td><td colspan="3">Value</td></tr>
<tr><td>5F2E</td><td>variable</td><td colspan="3">Biometric data template defined in ISO/IEC 7816-11.</td></tr>
<tr><td></td><td></td><td>Tag</td><td>Length</td><td>Value</td></tr>
<tr><td></td><td></td><td>A1</td><td>variable</td><td>Biometric data in standardized format (Constructed)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>ISO/IEC 19794 -4, -5, -6</td></tr>
</table>

ISO/IEC 39794 embedding ISO/IEC in Doc 9303

<table>
<tr><td>Tag</td><td>Length</td><td colspan="5">Value</td></tr>
<tr><td>7F2E</td><td>variable</td><td colspan="5">Biometric data template defined in ISO/IEC 7816-11.</td></tr>
<tr><td></td><td></td><td>Tag</td><td>Length</td><td colspan="3">Value</td></tr>
<tr><td></td><td></td><td>A1</td><td>variable</td><td colspan="3">Biometric data in standardized format (Constructed)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Tag</td><td>Length</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>64, 65, 66</td><td>variable</td><td>ISO/IEC 39794 -4, -5, -6 ASN.1</td></tr>
</table>

Changed Identifier Tag

- 5F2E - ISO/IEC 19794 series first edition
- 7F2E - ISO/IEC 39794 series

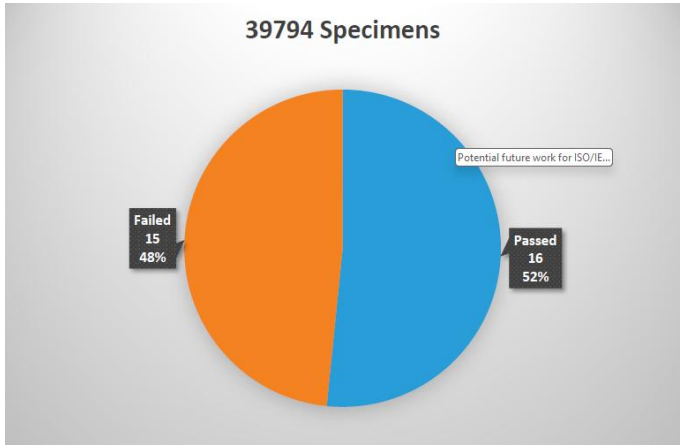
ISO/IEC 39794

- 64 [APPLICATION 4] - fingerprint
- 65 [APPLICATION 5] - facial image
- 66 [APPLICATION 6] - iris image

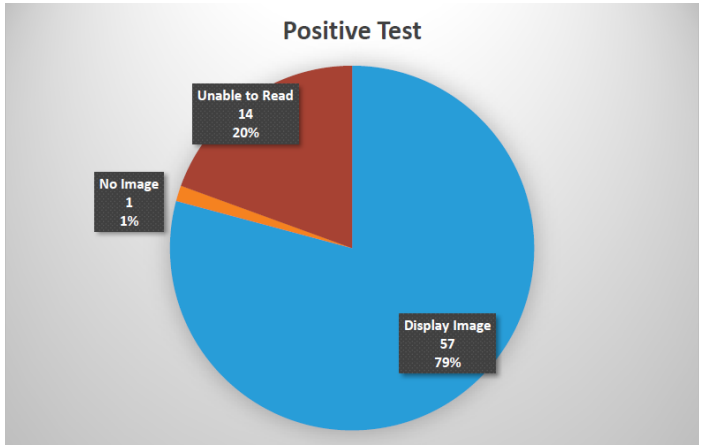
Interoperability tests

- ICAO performs interoperability tests to prove the migration from 19794-5:2005 to 39794-5:2019
- Inspection Systems need to be ready by 2026 to handle the new encoding
- Issuers to switch to new encoding by 2030
- Interoperability event for testing readiness of Issuers and Inspection Systems – **Sydney, October 2024**
  [Source: Report ISO/IEC SC17 WG3 by R Rajeshkumar]

- Passports/ID cards with 39794 encoded



- Reader able to read DG2 with 39794



Potential future work for ISO/IEC 39794 series

- ISO/IEC 39794 series is an extensible format
  - Ability to add further biometric and meta information as technology advances
- Adding further modalities
  - ISO/IEC 39794-12 Fingermark Images is currently worked on
- ASN.1 and XML are object-oriented data notations
  - Ability to extend to further notations (JSON, CBOR) if required by the industry

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Thank you

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